

Bell Work
24-April-18

**Please compute the “ $-\log(7)$ ”
using your calculator?**

What are acids and bases?

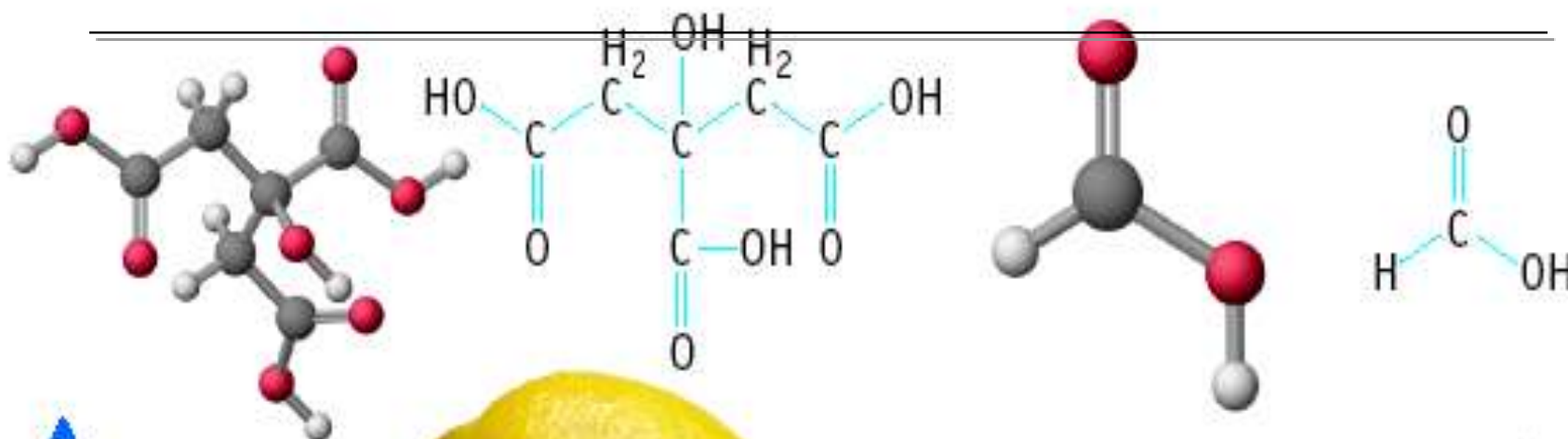
EQ: What bases have you used today and how did they help you?

Agenda:
introduction to Acid Base Chemistry

Objective:

Following the lesson you will be able to name simple acids and bases, know a general definition of an acid, and know how acids and bases taste

Acid and Bases



▲ The tartness of lemons and oranges comes from the weak acid citric acid. The acid is found widely in nature and in many consumer products.
(Charles D. Winters)



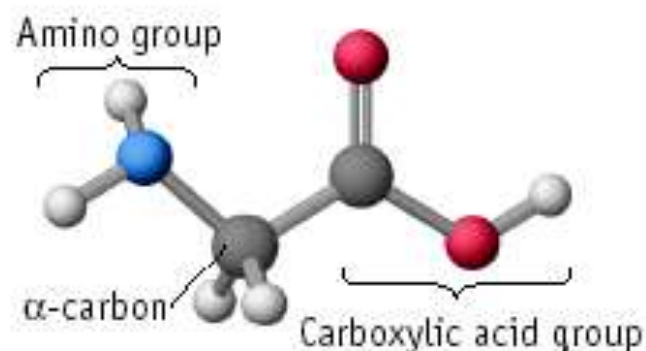
▲ The sting of ants is due to the weak acid formic acid, HCO_2H .
(Gallo Images/@ CORBIS)



Acid and Bases



▲ Aspirin is a weak acid that has been used as an analgesic for over 100 years.
(Charles D. Winters)

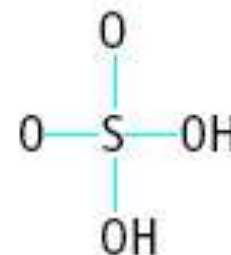


▲ Glycine is representative of the amino acids that are the basis of proteins. The $-\text{CO}_2\text{H}$ group is the acid portion of the molecule, and the $-\text{NH}_2$ group is the basic portion. (Charles D. Winters)

Acid and Bases



▲ Caffeine is a well known stimulant and a weak base. (Charles D. Winters)



▲ A sea slug excretes the strong acid sulfuric acid in self-defense. (Sharksong/M. Kazmers/Dembinski Photo Associates)



Acids

Multiple definitions:

Lewis

Arrhenius

Bronsted Lowry

Generally it's a chemical compound that produces a hydrogen ion concentration higher than pure water:
 $[H^+]$ or $[H_3O^+]$



Acids



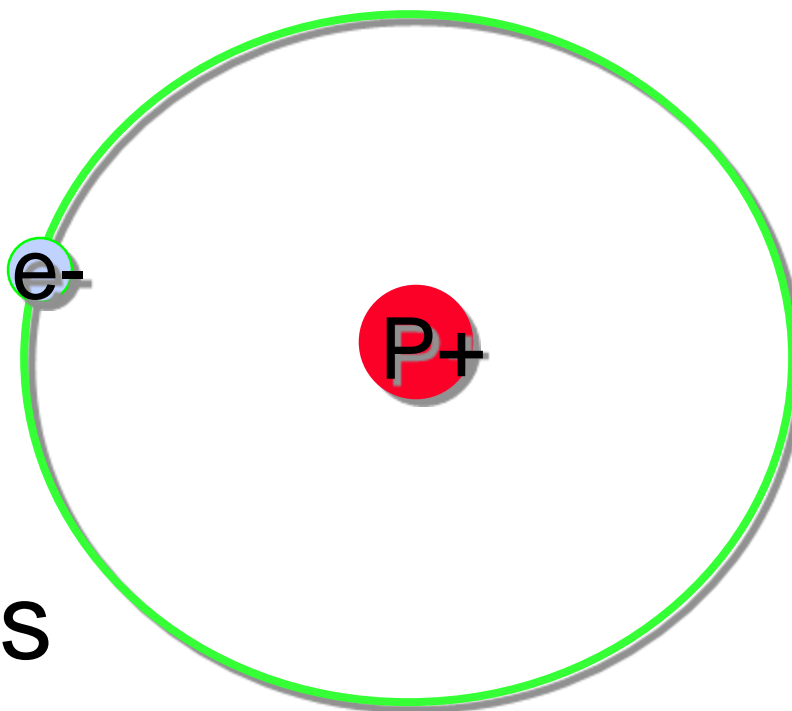
React with carbonates and bicarbonates to produce carbon dioxide gas

Have a sour taste. Vinegar is a solution of acetic acid. Citrus fruits contain citric acid.

Some Properties of Acids

Produce H^+ (as H_3O^+ ions in water):

Call a “proton”



Taste sour

Corrode metals

Acid Nomenclature Review

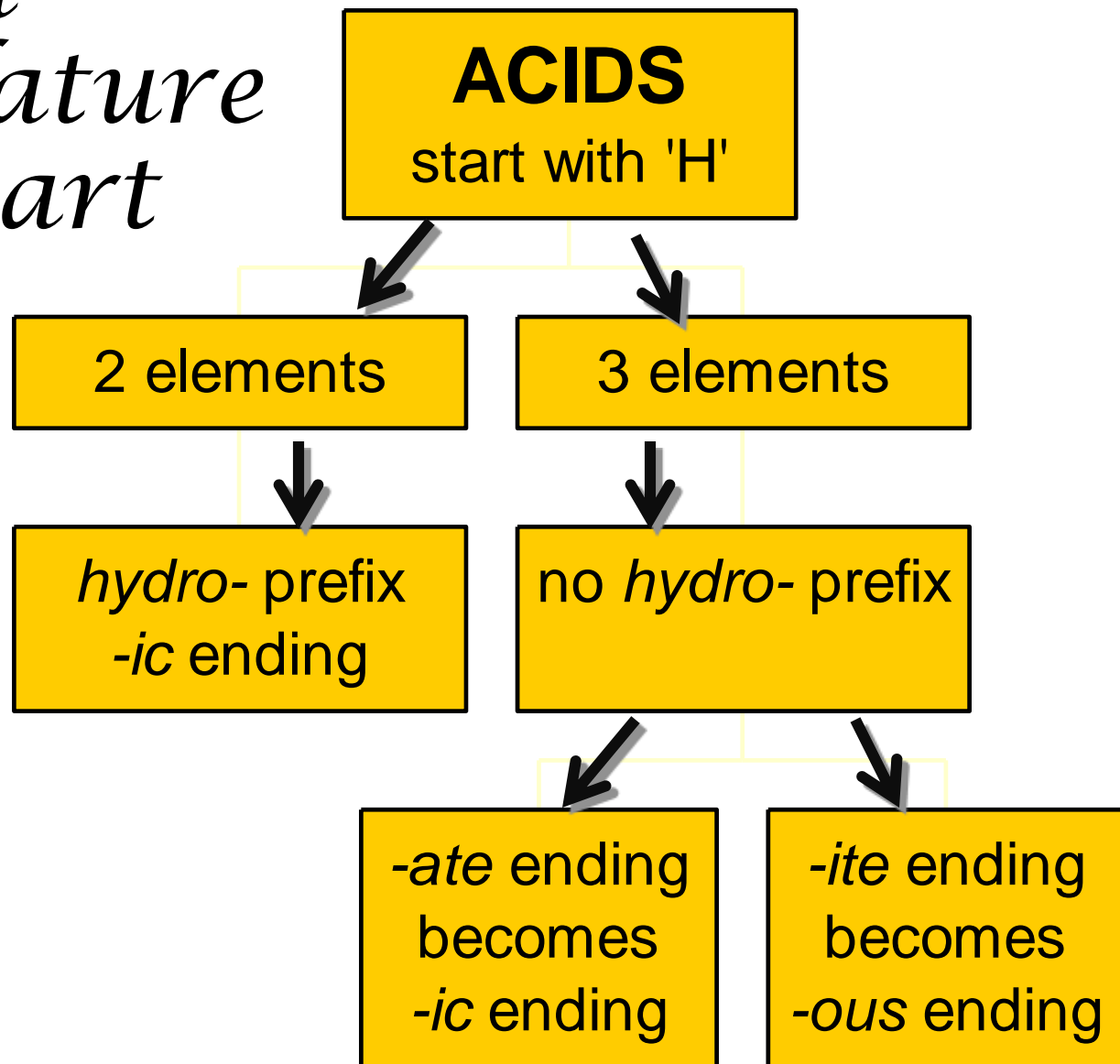
Anion Ending		Acid Name
Binary	→ -ide	hydro-(stem)-ic acid
Ternary	→ -ate	(stem)-ic acid
	→ -ite	(stem)-ous acid

Acid Nomenclature Review

*An easy way to remember which goes
with which...*

*“In the cafeteria, you ATE something
ICky”*

Acid Nomenclature Flowchart



Acid Nomenclature Review

$\text{HBr}_{(\text{aq})} \Rightarrow$ hydrobromic acid

$\text{H}_2\text{CO}_3 \Rightarrow$ carbonic acid

$\text{H}_2\text{SO}_3 \Rightarrow$ sulfurous acid

Strong Acids

Completely dissociates in water.

You will need to remember these three:



Name 'Em!

HF

HCl

H₂SO₄

HNO₃

HIO₃

Which are
strong acids?



Bases

A chemical species that donates hydroxide ions (OH^-) or that accepts protons.

Have a bitter taste.

Feel slippery. Many soaps contain bases.

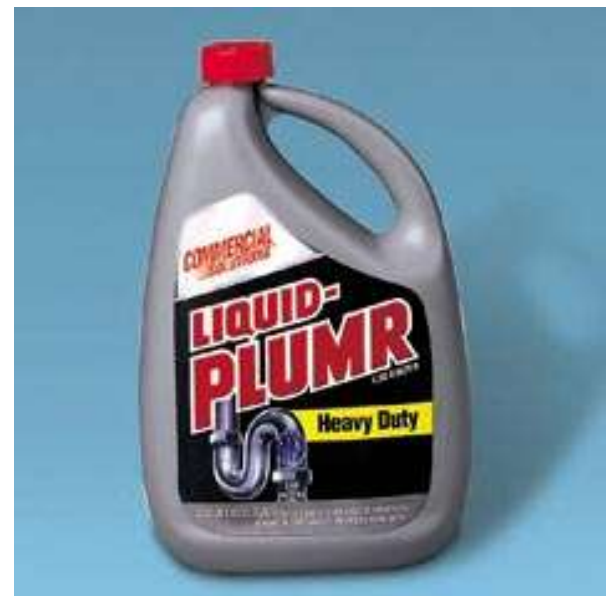
Some Properties of Bases

Produce OH^- ions in water

Taste bitter, chalky

Are electrolytes

Feel soapy, slippery



Name these Common Bases

NaOH

Drain cleaner

KOH

Liquid soap

Ba(OH)₂

Stabilizer for plastics

Mg(OH)₂

Milk of magnesia

Al(OH)₃

Maalox (antacid)

Naming Bases

Group I metals all form strong bases with hydroxide

Same name as chemical name

Ex. NaOH – Sodium hydroxide

List the rest of them (write their names and chemical formulas)

KNOW THEM

Recall...

In your own words define:

What an acid and base are,

How can you distinguish
them,

How do you name them

Bell Work

25.April.2018

Name the following acids and bases:

CsOH

HBr

HNO₂

Write the correct formula for the following acid and bases

Ammonia

Acetic Acid

Carbonic Acid

Hydroiodic Acid

Introduction to pH

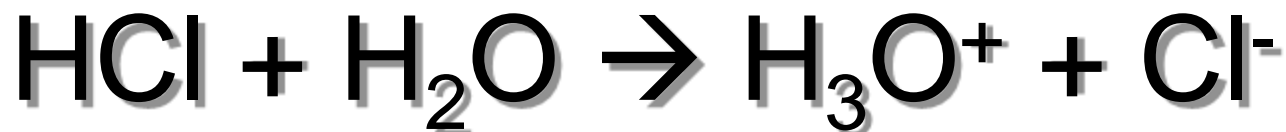
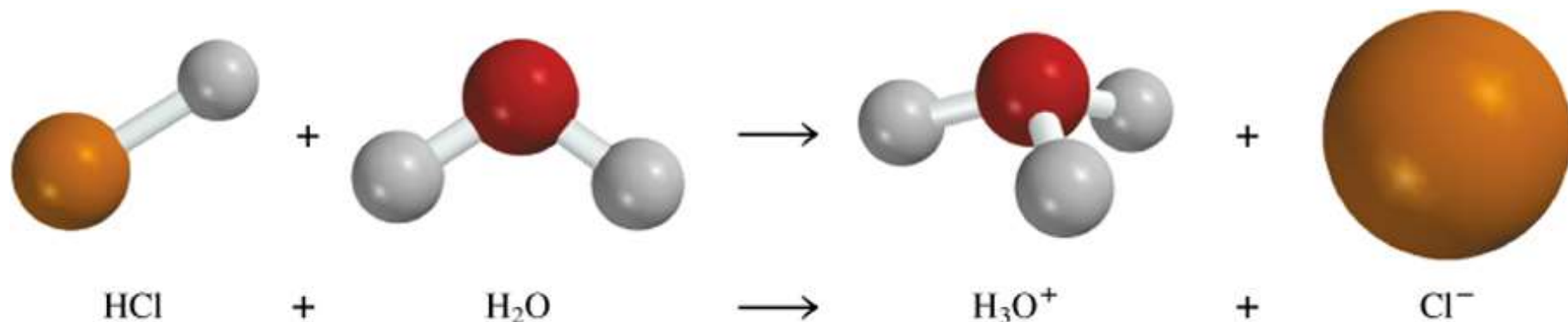
**PhET Simulation on class website under labs
“Under Standing pH”**

Due 30April2018

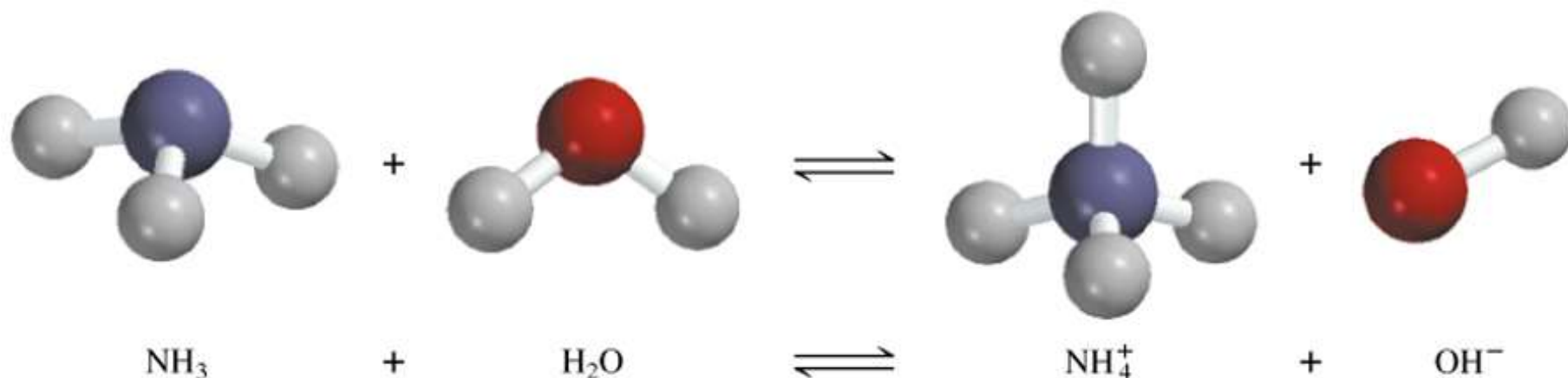
Visual Introduction to Acid Base Chemistry

Complete one more section B, C, or D today

Arrhenius acid: “is a substance that produces H^+ (H_3O^+) in water”



Arrhenius base: “is a substance that produces OH⁻ in water”



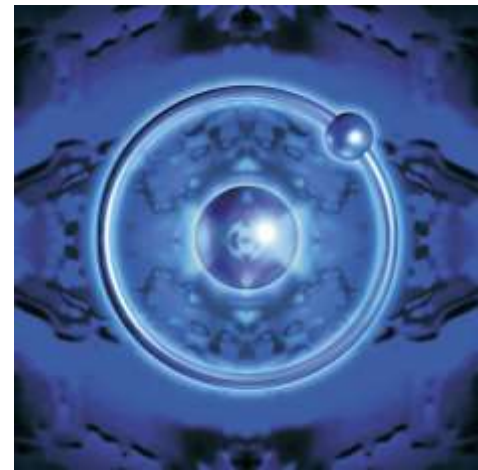
Acid/Base Definitions

Definition #2 Brønsted – Lowry

Acids – proton donor

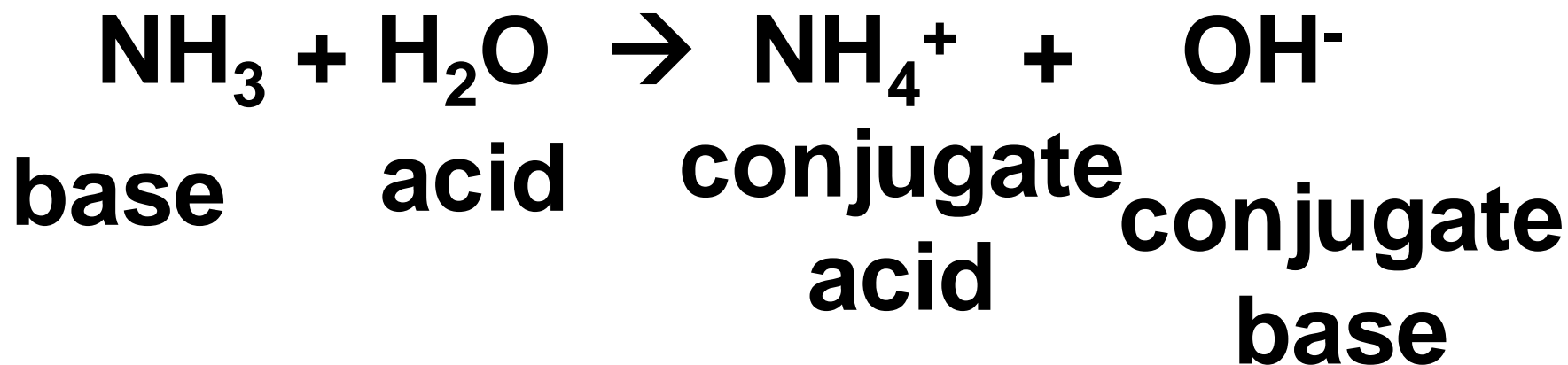
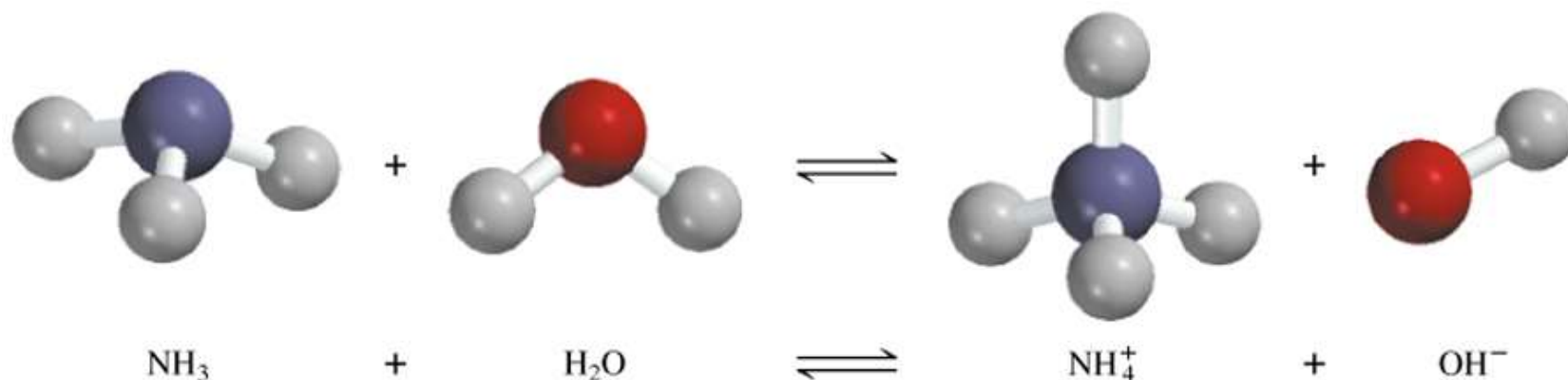
Bases – proton acceptor

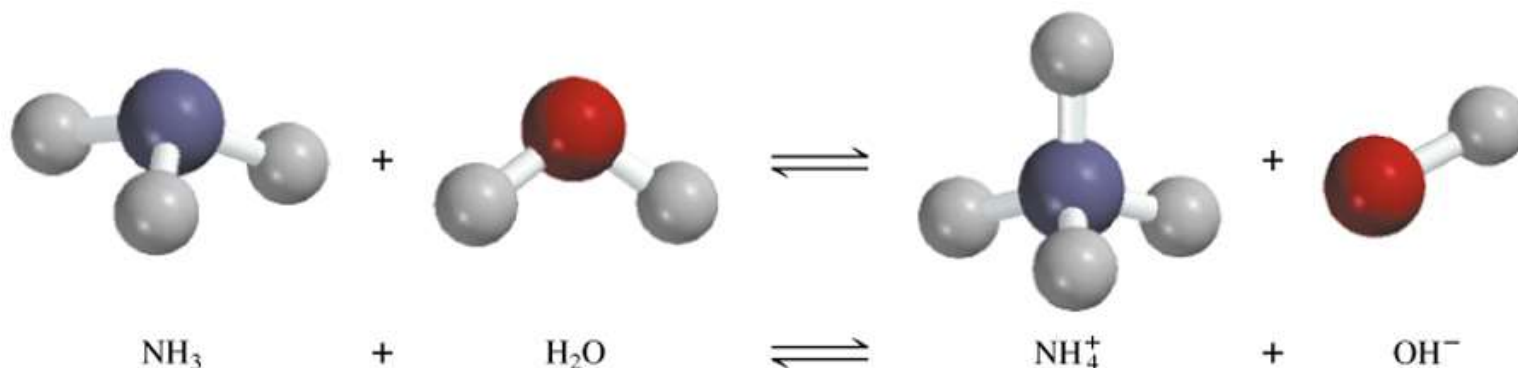
A “proton” is really just a hydrogen atom that has lost its e^- !



A Brønsted-Lowry acid is a proton donor

A Brønsted-Lowry base is a proton acceptor

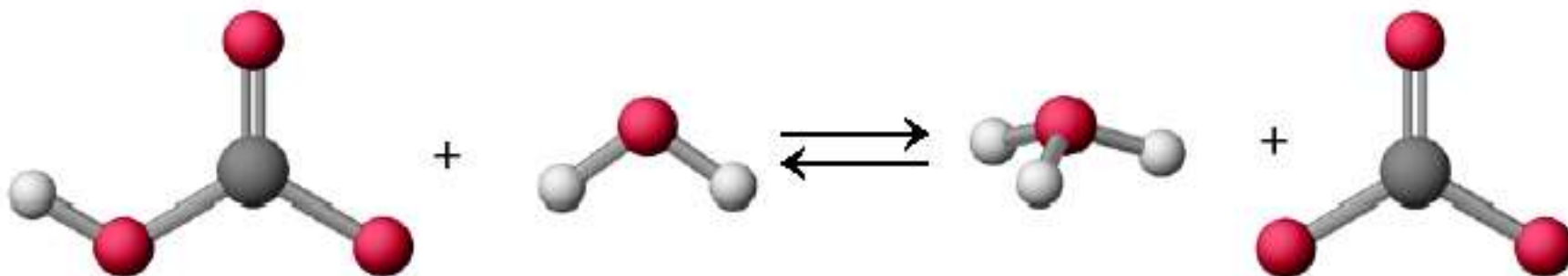
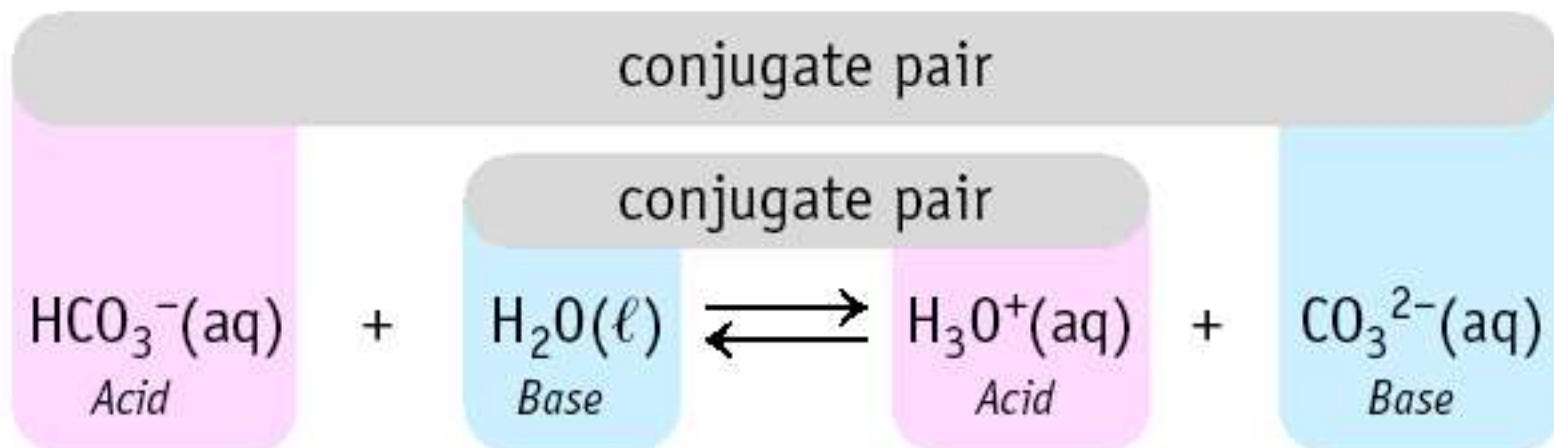




conjugate acid: substance formed when base gains a hydrogen ion

conjugate base: substance formed when an acid loses a hydrogen ion

Conjugate Pairs



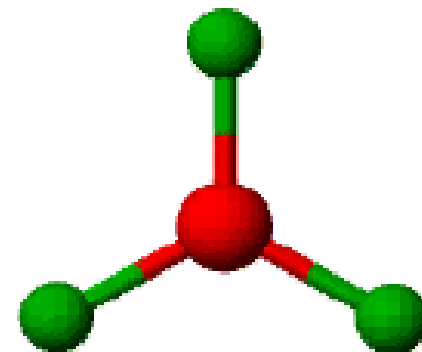
Suggested Practice Homework

Read 574-576, and #1-2

Acids & Base Definitions

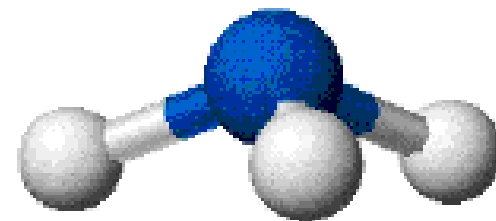
Definition #3: Lewis

Lewis acid - a substance that accepts an electron pair



BF_3 , the boron atom is surrounded by only three electron pairs.

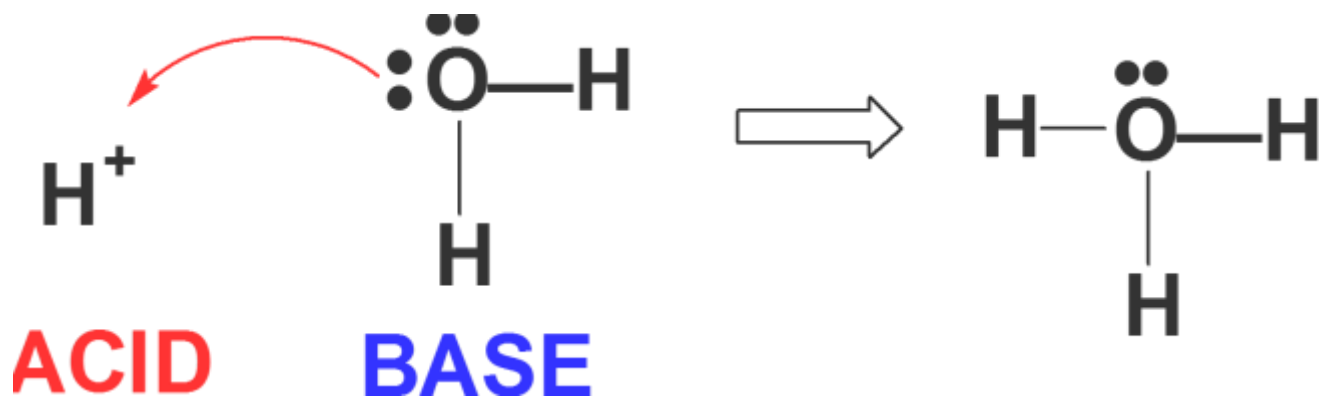
Lewis base - a substance that donates an electron pair



NH_3 , the N atom has three bond pairs and one lone pair of electrons.

Lewis Acids & Bases

Formation of hydronium ion is also an excellent example.



Electron pair of the new O-H bond originates on the Lewis base.

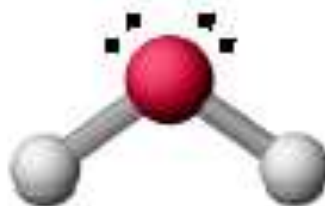
Lewis Acid/Base Reaction

Lewis Acid

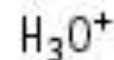
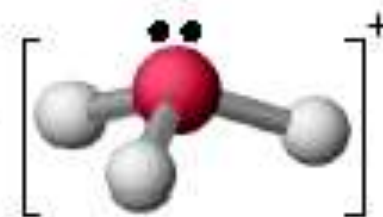


+

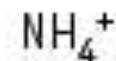
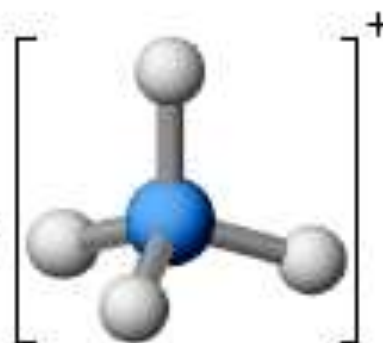
Lewis Base



Adduct



+



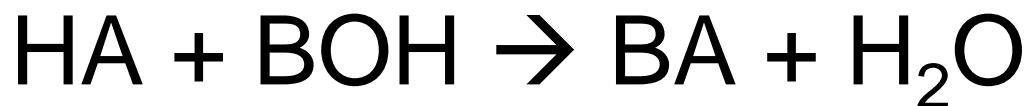
Learning Check!

Label the acid, base, conjugate acid, and conjugate base in each reaction:



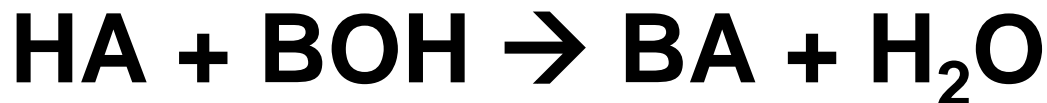
For most Acid Bases Rxns

The generic equation for most acid base rxn is:

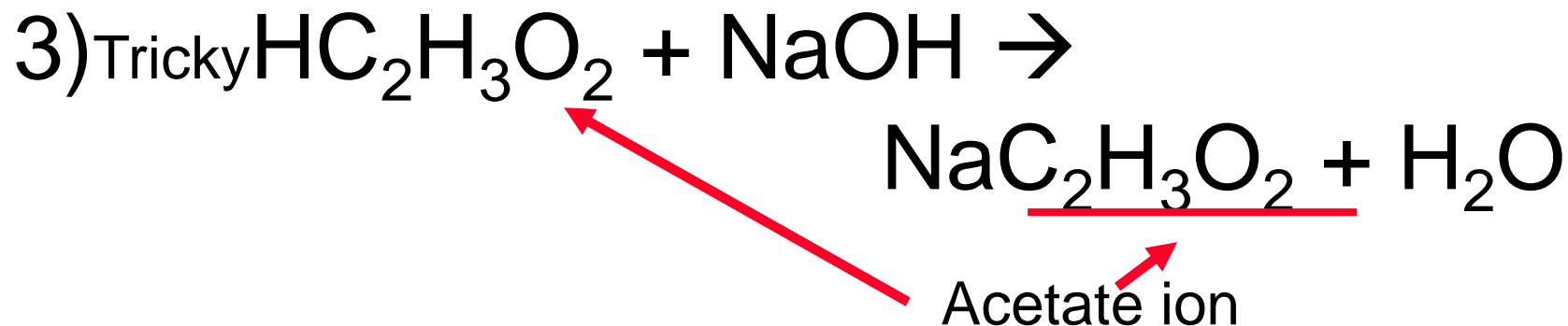
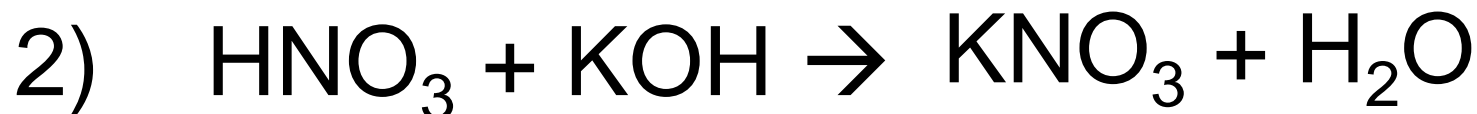
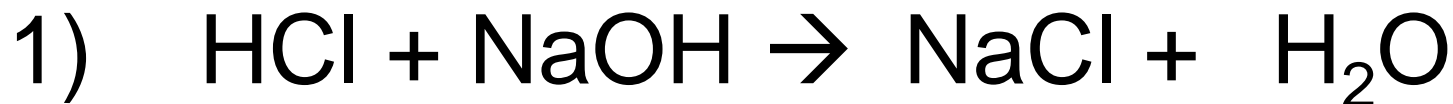


You will get a salt and water out of an acid base rxn!

You try... write out the products:

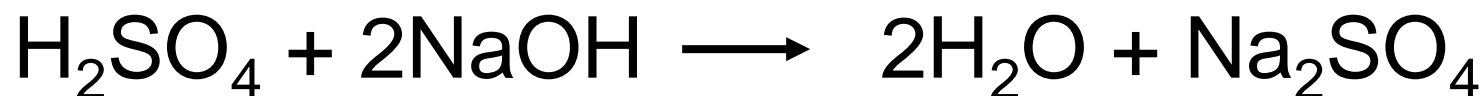


You will get a salt and water out of an acid base rxn!



What volume of a 1.420 M NaOH solution is required to titrate 25.00 mL of a 4.50 M H₂SO₄ solution?

WRITE THE BALANCED CHEMICAL EQUATION!



volume acid $\xrightarrow[\text{acid}]{M}$ moles acid $\xrightarrow[\text{Bridge}]{\text{Mole}}$ moles base $\xrightarrow[\text{base}]{M}$ volume base

$$\cancel{25.00 \text{ mL}} \times \frac{\cancel{4.50 \text{ mol H}_2\text{SO}_4}}{\cancel{1000 \text{ mL soln}}} \times \frac{\cancel{2 \text{ mol NaOH}}}{\cancel{1 \text{ mol H}_2\text{SO}_4}} \times \frac{1000 \text{ mL soln}}{\cancel{1.420 \text{ mol NaOH}}} = 158 \text{ mL}$$

Suggested Practice Homework

Read 580, and #9-12

Bell Work

26-April-18

What are the strong acids you must know?

What is the conjugate base in the reaction below?



What do bases taste like?

Agenda

Acid base definitions

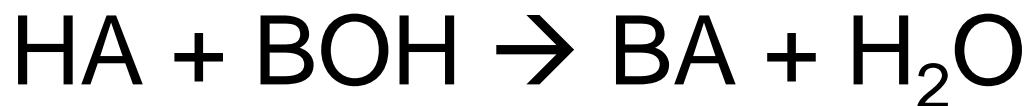
pH

Objective:

You will be able to describe the pH scale.

For most Acid Bases Rxns

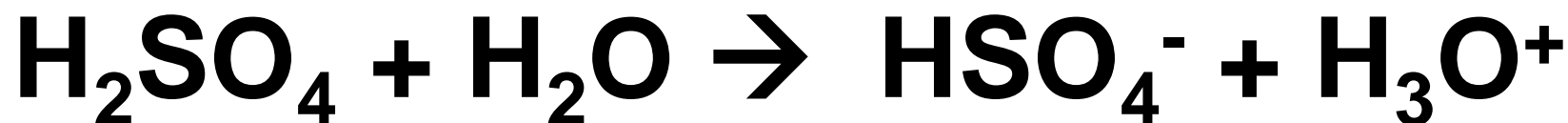
The generic equation for most acid base rxn is:



You will get a salt and water out of an acid base rxn!

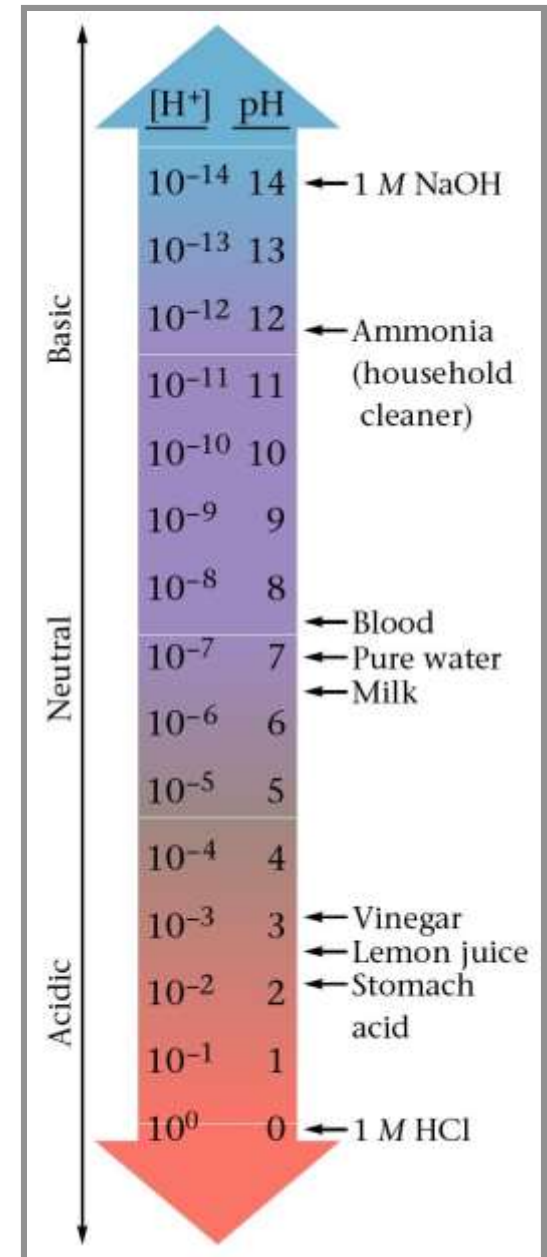
Recap!

Identify the acid, base, and conjugate acid and base in each equation:



pH scale = way of expressing the strength of acids & bases. Instead of using very small #'s, we just use the **NEGATIVE** power of 10 on the Molarity of the H^+ (or OH^-) ion.

Under 7 = acid
 7 = neutral
 Over 7 = base



pH of Common Substances



Figure 5.17 pH values of some common substances. Here the “bar” is colored red at one end and blue at the other. These are the colors of litmus paper, commonly used in the laboratory to decide if a solution is acidic (litmus is red) or basic (litmus is blue). (Charles D. Winters)

Agenda

Acid base definitions

pH

pH \rightarrow $[H^+]$

Objective:

You will start to look at calculating pH and $[H^+]$ and be able to describe the pH scale.

Calculating the pH

$$\text{pH} = -\log [\text{H}^+]$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+]$$

(Remember that the [] mean Molarity)

Example: If $[\text{H}^+] = 1 \times 10^{-10}$

$$\text{pH} = -\log 1 \times 10^{-10}$$

$$\text{pH} = -(-10)$$

$$\text{pH} = 10$$

For a strong acid $[\text{H}^+] \sim$ the molarity of the solution

Calculating the pH

$$\text{pH} = -\log [\text{H}^+]$$

(Remember that the [] mean Molarity)

Example: If $[\text{H}^+] = 1.8 \times 10^{-5}$

$$\text{pH} = -\log 1.8 \times 10^{-5}$$

$$\text{pH} = -(-4.74)$$

$$\text{pH} = 4.74$$

Try These!

Find the pH of these:

- 1) A 0.15 M solution of Hydrochloric acid
- 2) A 3.00×10^{-7} M solution of Nitric acid
- 3) A 6.0M solution of Sulfuric acid

pH Cals. Solving for $[H^+]$

If the pH of Coke is 3.12, $[H^+] = ???$

Because $pH = -\log [H^+]$ then

$$-pH = \log [H^+]$$

Take antilog (10^x) of both sides and get

$$10^{-pH} = [H^+]$$

$$[H^+] = 10^{-3.12} = 7.6 \times 10^{-4} \text{ M}$$

*** to find antilog on your calculator, look for “Shift” or “2nd function” and then the “log” button



Homework

Finish pH Acid Base Practice up to Titrations

Practice

What is the pH of a solution with a proton concentration of 0.032 M?

What is the proton concentration in a solution with pH of 9.24?

pH Cals. Solving for H⁺

A solution has a pH of 8.5. What is the Molarity of hydrogen ions in the solution?

$$\text{pH} = -\log [\text{H}^+]$$

$$8.5 = -\log [\text{H}^+]$$

$$-8.5 = \log [\text{H}^+]$$

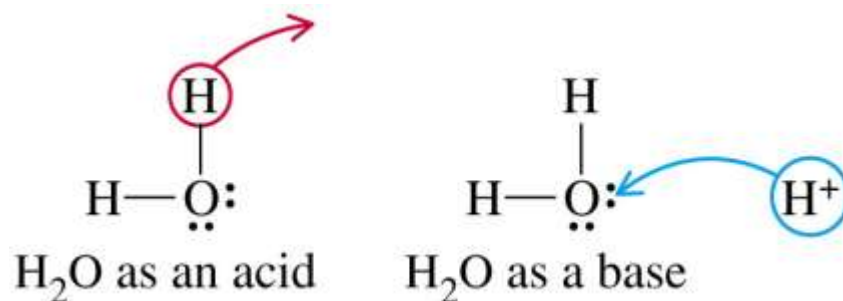
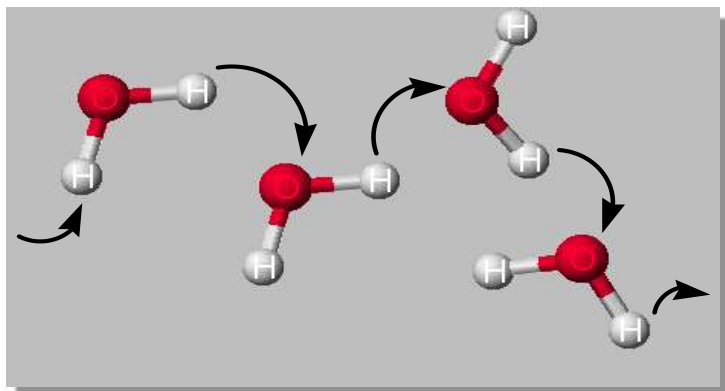
$$\text{Antilog } -8.5 = \text{antilog} \\ (\log [\text{H}^+])$$

$$10^{-8.5} = [\text{H}^+] \rightarrow \mathbf{3.16 \times 10^{-9} \text{ M}}$$

More about Water

H₂O can act as both an ACID & a BASE.

In pure water there can be
AUTOIONIZATION

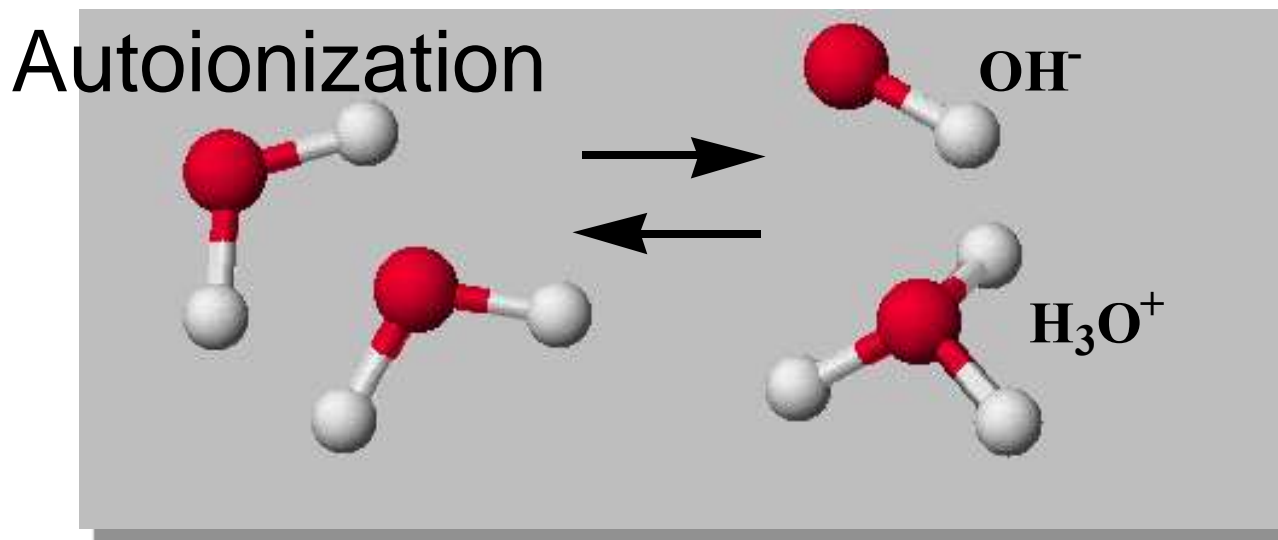


Equilibrium constant for water = K_w

$$K_w = [\text{H}_3\text{O}^+] [\text{OH}^-] = 1.00 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

$$K_w = [\text{H}^+] [\text{OH}^-] =$$

More about Water



$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.00 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

In a neutral solution $[\text{H}_3\text{O}^+] = [\text{OH}^-]$

$$\text{so } K_w = [\text{H}_3\text{O}^+]^2 = [\text{OH}^-]^2$$

$$\text{and so } [\text{H}_3\text{O}^+] = [\text{OH}^-] = 1.00 \times 10^{-7} \text{ M}$$

pOH

Since acids & bases are opposites, pH and pOH are opposites!

pOH does not really exist, but it is useful for changing bases to pH.

$$\underline{pOH = -\log [OH^-]}$$

Since pH and pOH are on opposite ends of scale,

$$pH + pOH = 14$$

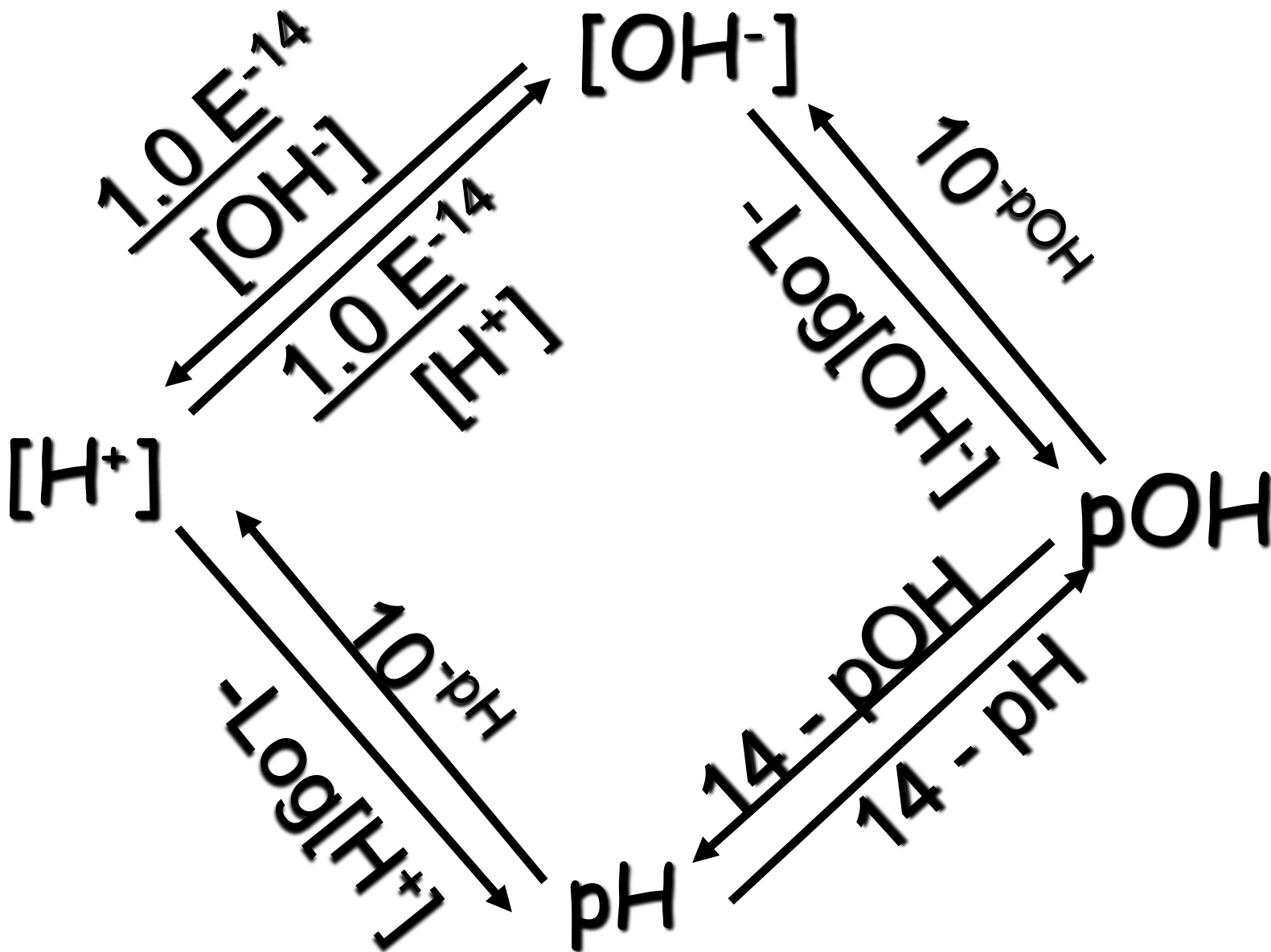
$$\mathcal{K}_w$$

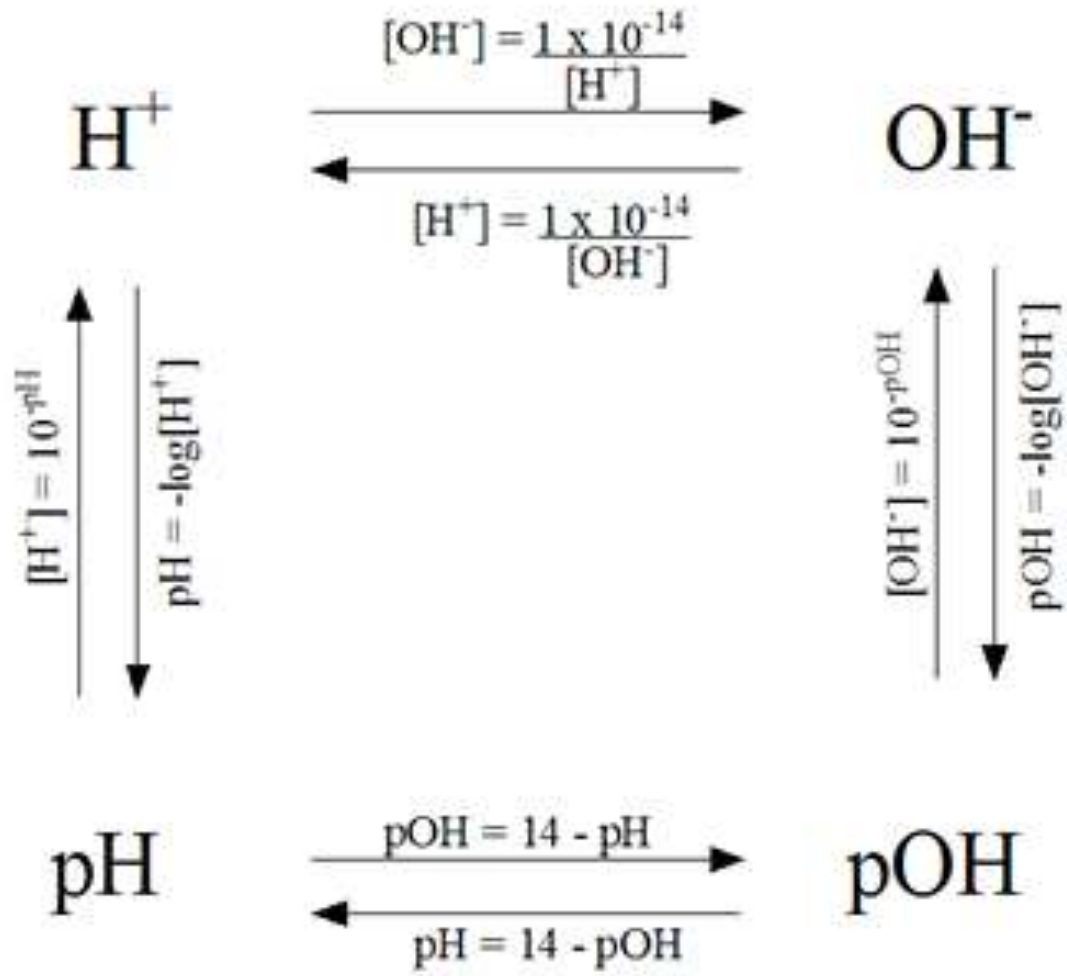
Water dissociation
constant; K_w .

$$K_w = 1.0 \times 10^{-14}$$

$$K_w = [\text{H}^+][\text{OH}^-]$$

$$1.0 \times 10^{-14} = [\text{H}^+][\text{OH}^-]$$





Bell Work 1.May.2017

A student dilutes concentrated hydrochloric acid to make two solutions:

(a) 3.0 M

(b) 0.0024 M.

Calculate the $[H^+]$, pH, $[OH^-]$, and pOH of the two solutions at 25°C.

EQ:

Why is pH so misunderstood?

Objective

Are you up to speed?

pH, $[H^+]$, etc. calculation Recap

Quick Quiz #2.8, p3

1. On the pH scale bases would be what range?

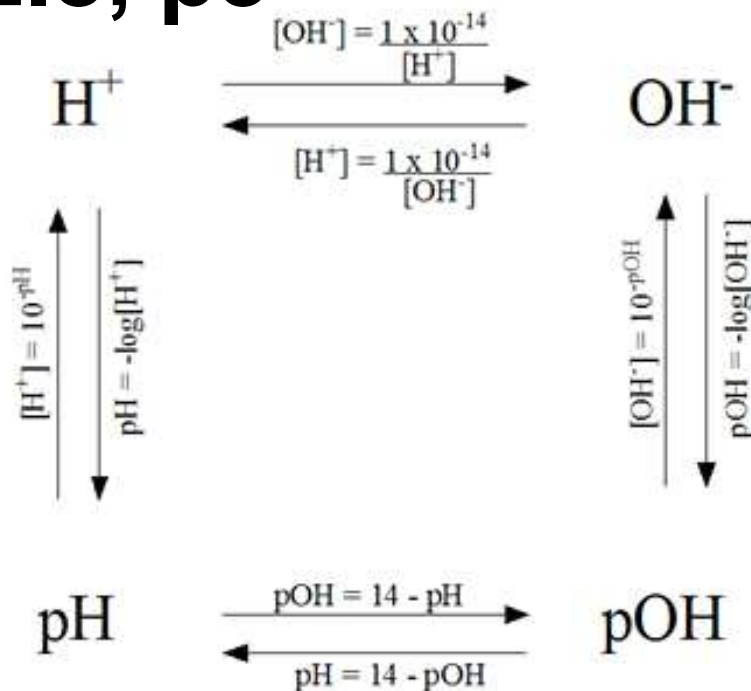
2. In the rxn below what is the acid?



3. List the three strong acids you must know?

4. If a solution is made by dissolving 2.5g of KOH (MM 56.0 g/mol) to a vol. of 1.0L, what is the pH?

5. A 0.220M solution of an acid has a pH of 4.26. What is the $[\text{H}^+]$?



Quick Quiz #2.8, p.3

1. On the pH scale bases would be what range?

>7

2. In the rxn below what is the acid?



3. List the three strong acids you must know?

HCl, HNO₃, H₂SO₄

4. If a solution is made by dissolving 2.5g of KOH (MM 56.0 g/mol) to a volume of 1.0L, what is the pH?

12.65

5. A 0.220 M solution of an acid has a pH of 4.26. What is the [H⁺]? **5.49E⁻⁵**

Quick Quiz #2.8

1. On the pH scale bases would be what range?

>7

2. In the rxn below what is the acid?



3. List the three strong acids you must know?

HCl, HNO₃, H₂SO₄

4. If a solution is made by dissolving 1.5g of KOH (MM 56.0 g/mol) to a volume of 1.0L, what is the pH?

12.43

5. A 0.120 M solution of an acid has a pH of 3.26. What is the [H⁺]? **5.49E⁻⁴**

Quick Quiz #2.8

1. On the pH scale bases would be what range?

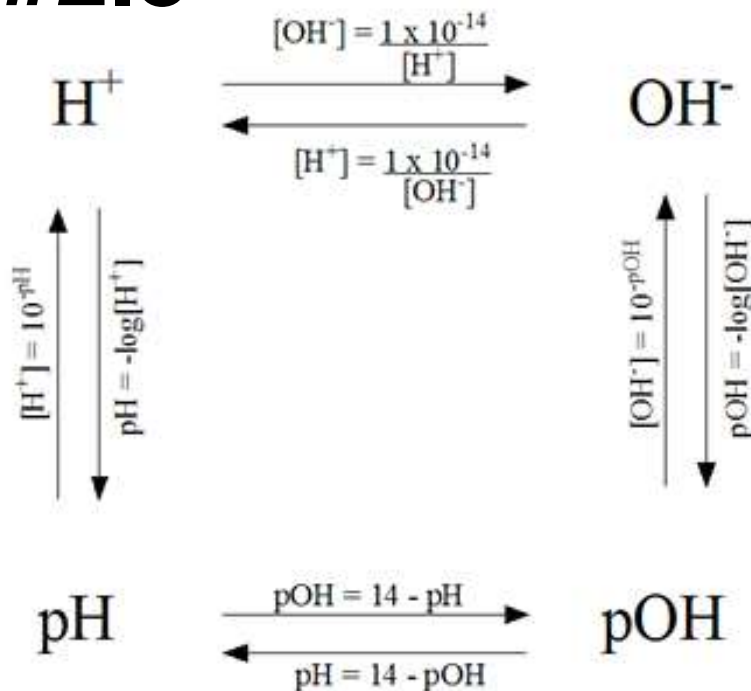
2. In the rxn below what is the acid?



3. List the three strong acids you must know?

4. If a solution is made by dissolving 1.5g of KOH (MM 56.0 g/mol) to a vol. of 1.0L, what is the pH?

5. A 0.120M solution of an acid has a pH of 3.26. What is the $[\text{H}^+]$?



pH testing

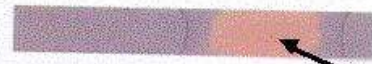
There are several ways to test pH

- Blue litmus paper (red = acid)
- Red litmus paper (blue = basic)
- pH paper (multi-colored)
- pH meter (7 is neutral, <7 acid, >7 base)
- Universal indicator (multi-colored)
- Indicators like phenolphthalein
- Natural indicators like red cabbage, radishes

Red litmus paper with a drop of base here



Blue litmus paper with a drop of acid here



Paper testing

Paper tests like litmus paper and pH paper





- Place a drop of the solution from the end of the stirring rod onto a piece of the paper
- Read and record the color change. Note what the color indicates.
- You should only use a small portion of the paper. You can use one piece of paper for several tests.



pH paper

Behavior of Salts in Water

Table 18.8 The Behavior of Salts in Water

Salt Solution (Examples)	pH	Nature of Ions	Ion That Reacts with Water	
Neutral [NaCl, KBr, Ba(NO ₃) ₂]	7.0	Cation of strong base Anion of strong acid	None	
Acidic [NH ₄ Cl, NH ₄ NO ₃ , CH ₃ NH ₃ Br]	<7.0	Cation of weak base Anion of strong acid	Cation	
Acidic [Al(NO ₃) ₃ , CrCl ₃ , FeBr ₃]	<7.0	Small, highly charged cation Anion of strong acid	Cation	
Basic [CH ₃ COONa, KF, Na ₂ CO ₃]	>7.0	Cation of strong base Anion of weak acid	Anion	

pH meter

Tests the voltage of the electrolyte

Converts the voltage to pH

Very cheap, accurate

Must be calibrated with a buffer solution



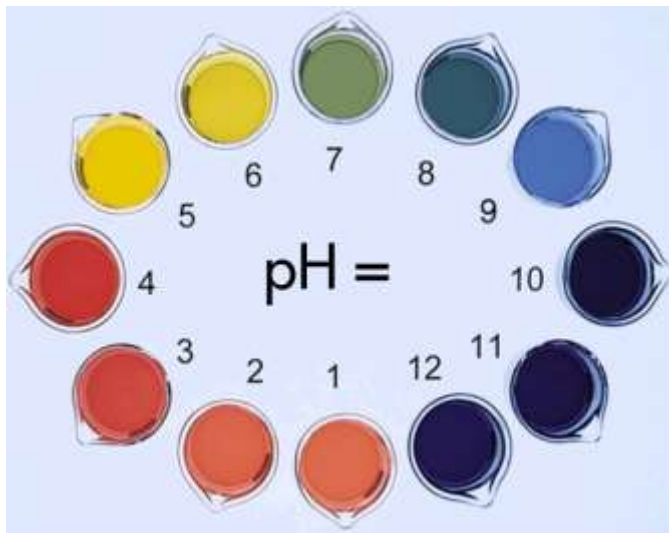
pH indicators

Indicators are dyes that can be added that will change color in the presence of an acid or base.

Some indicators only work in a specific range of pH

Once the drops are added, the sample is ruined

Some dyes are natural, like radish skin or red cabbage



Bell Work 2May2017

Write the balance equation for sodium hydroxide reacting with hydrochloric acid.

If **10.0mL** of sodium hydroxide is reacted (neutralized) with **25.0mL** of **0.05M** hydrochloric acid, what is the concentration of the sodium hydroxide?

EQ: Why is pH so misunderstood?

Objective

**You will be able to set up a burette and
dispense specific quantities of analyte to a
reaction flask**

Titration; Setting up Burette

1. Attach to ring stand using burette clamp
2. Open burette and rinse with DI water into a waste beaker.
3. Close burette after all DI water and drained through run 2-5mL of through burette to coat sides.
4. Close burette and load titrant, run just enough titrant through burette to remove all air bubbles from spout.

**Titrant; what you know
(known concentrations)**

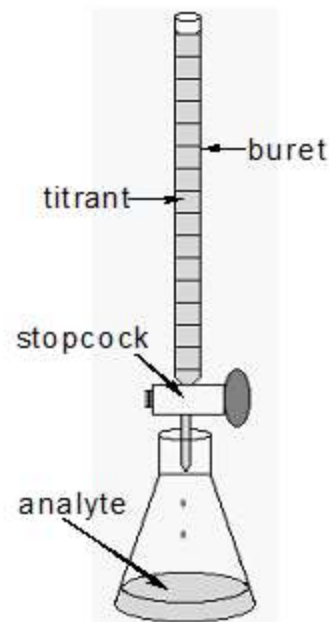


Figure 1: Titration Setup

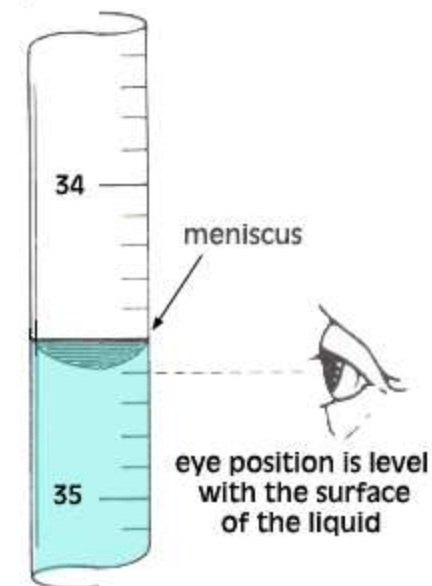
**Analyte; what you
are trying to find**

Titration, Reading a Burette:

Make sure burette is level.

5. Record initial volume by reading bottom of meniscus

6. After titration is complete, read final volume and record.



	Trial 1	Trail 2
Vol _{initial}		
Vol _{Final}		
Vol _{dispensed}		

Titration

- I. Practice rinsing burette and setting up for use.
- II. Load burette with titrant (just water today)
- III. Add known amount of analyte to a Erlenmeyer Flask (just water today)
- IV. Each person: Practice dispensing titrant in amounts of 10ml, 5mL, 2mL, 1mL, and 0.1mL.
- V. Clean up, always leave burette in the open position and make sure you have rinsed 2-3x with DI water!***

Acid Base Titration Calculations

Recall our dilution formula

$$M_1 V_1 = M_2 V_2$$

M = Molarity (mol/L)

V = Volume (L)

Think of it like this:

$$M_{\text{acid}} V_{\text{acid}} = M_{\text{base}} V_{\text{base}}$$

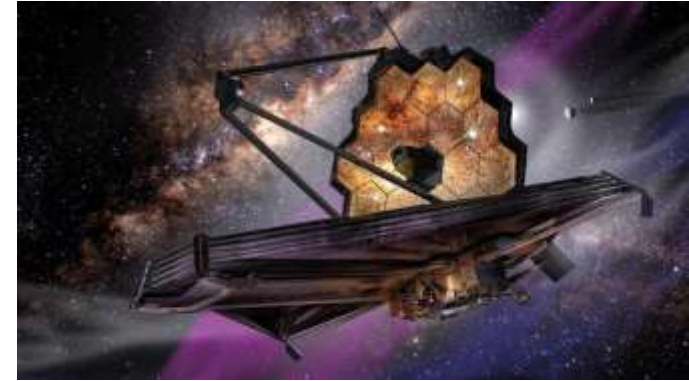
Final FWUSD STEM Lecture,

Who: Dr. Everett Schlawin

What: The James Webb Space Telescope and the Closest Yet Looks at New Worlds

When: Tuesday, May 2nd from 3:45pm-5:00pm

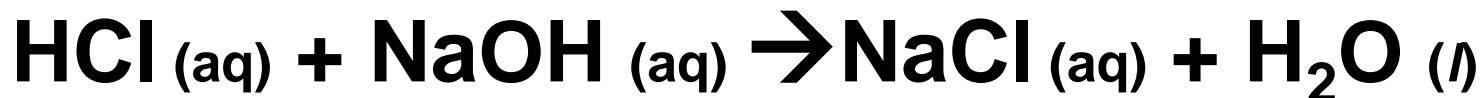
Where: Flowing Wells Board Room (note location change)



Talk Summary: The James Webb Space Telescope (JWST) is coming to a Lagrangian point near you! Set to launch in October 2018, JWST will be the largest ever space telescope. It will explore the darkest and deepest parts of the Universe as well as inspect exoplanets to levels that have never been achieved before. I will discuss the status of the telescope, the University of Arizona-led infrared camera called NIRCam and how JWST will explore new planets.

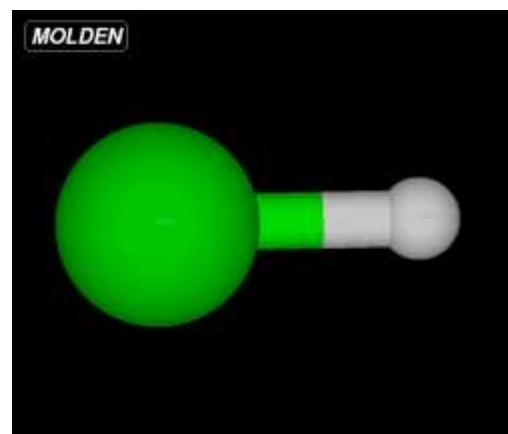
Extra Credit (5points) if you type up a 0.5-1.0page summery of the lecture including what you learned and how it applies to your life.
Due to Mr. Golden by 4May2017

Acid Base Rxn Titration



acid base

**Carry out this reaction using a
TITRATION.**



Practice

When ammonia reacts with water an ammonium ion and hydroxide is produced.

-Write a balanced equations.

-What type of base is ammonia if it is producing hydroxide?

Bell Work; 3-May-2017

**Please complete the “Intro to Titration Lab”,
data table on lower $\frac{1}{4}$ of a blank sheet of paper.**

	Trial 1	Trial 2	Trial 3	Trial 4
Molarity of NaOH				
Initial Burret reading (ml)				
Final Buret reading (ml)				
Amount of NaOH despined (ml)				
Vol. of Unknown acid used (ml)				
Molarity of unknown acid				

EQ:

Why is pH so misunderstood?

Objective

You will complete an acid base neutralization titration to end point in order to determine [HCl] solution.

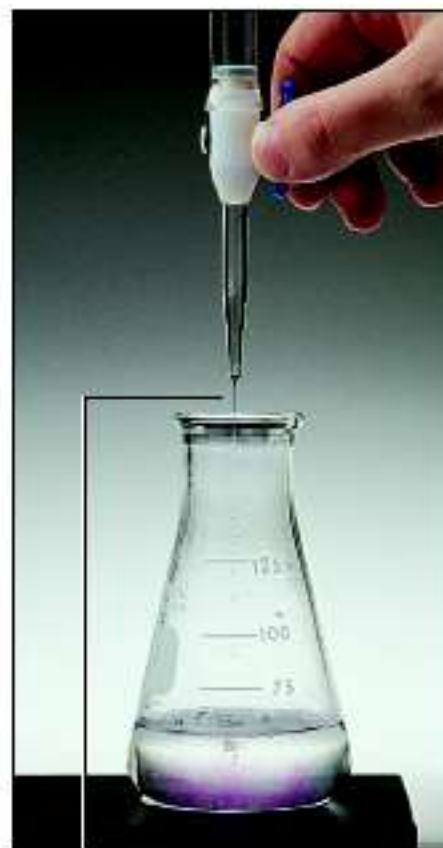
Intro To titration Lab, “what is actually happening!”

- 1. Why does the “pink” appear?**
- 2. Why does the rate of “pink” disappearance decrease as you approach the end point?**

Setup for titrating an acid w/ a base



(a)
50-mL buret containing aqueous NaOH of accurately known concentration



(b)
A solution of NaOH is added slowly to the sample being analyzed. The sample is mixed.



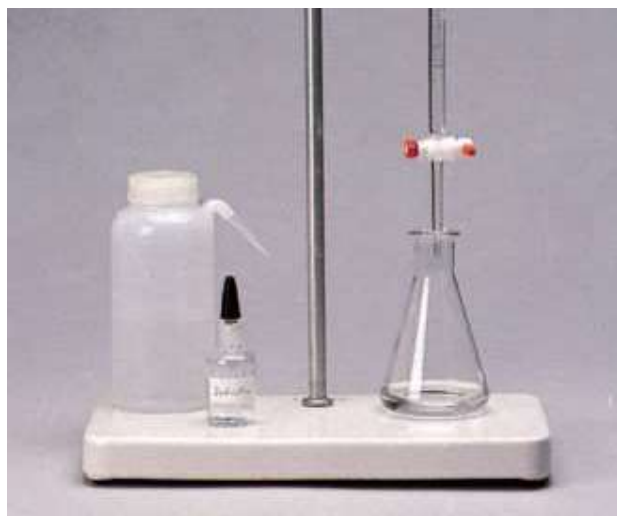
(c)
When the amount of NaOH added from the buret exactly equals the amount of H^+ supplied by the acid being analyzed, the dye (indicator) changes color.

Titration

In a *titration* a solution of accurately known concentration is added gradually to another solution of unknown concentration until the chemical reaction between the two solutions is complete.

Equivalence point the point at which the reaction is complete

Indicator – substance that changes color at (or near) the equivalence point



Slowly add base
to unknown acid
UNTIL
the indicator
changes color



Intro to Titrations

1. Add solution from the buret (base).
 2. Reagent (base) reacts with compound (acid) in solution in the flask.
 3. Indicator shows when exact stoichiometric reaction has occurred. $[\text{Acid}] = [\text{Base}]$
- This is called NEUTRALIZATION.



Bell Work 4-May-2017

A. What is a salt? (You best not say NaCl)

B. What is the concentration of HBr in an Erlenmeyer flask if it took 23.1mL of 0.05M to neutralize 15.0mL of it ?

Use stiochiometry and $M_a V_a = M_b V_b$

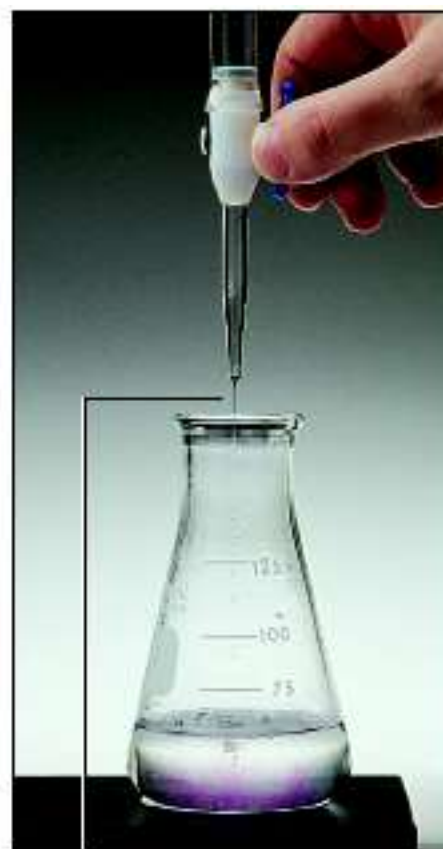
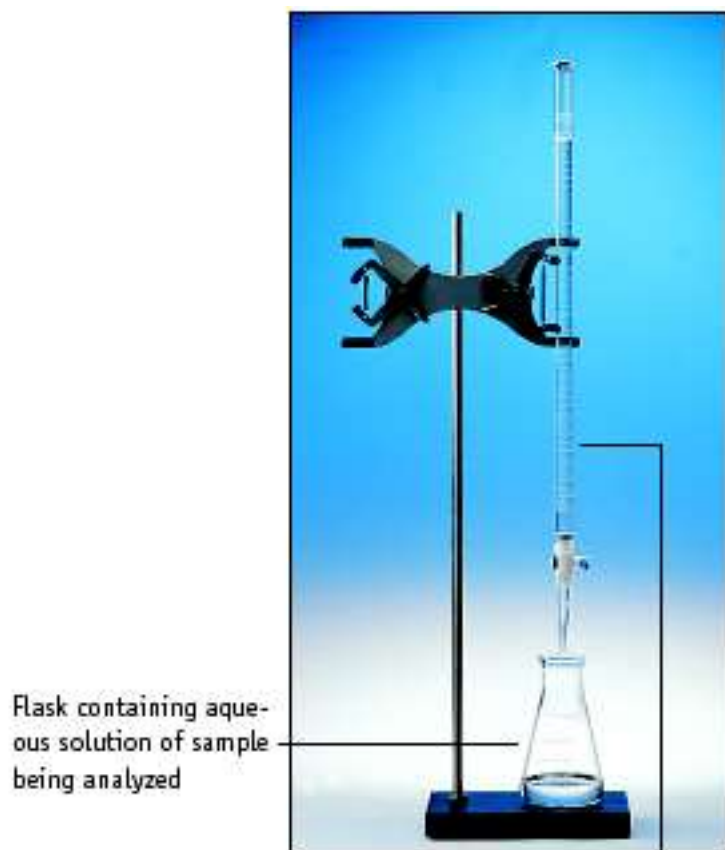
(Hint HBr : NaOH is 1H⁺: 1OH⁻)

EQ: Why is pH so misunderstood?

Objective

You will finish the Intro to titration complete an acid base neutralization titration to end point in order to determine [HCl] solution.

Setup for titrating an acid w/ a base



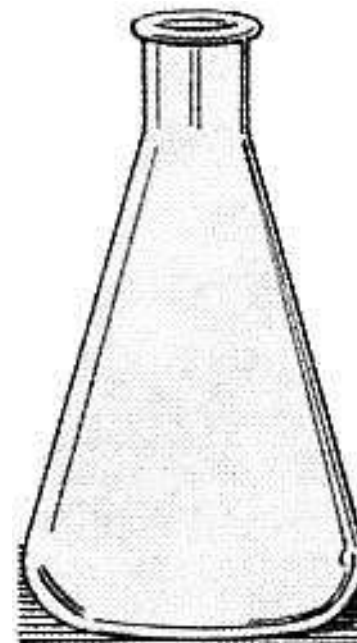
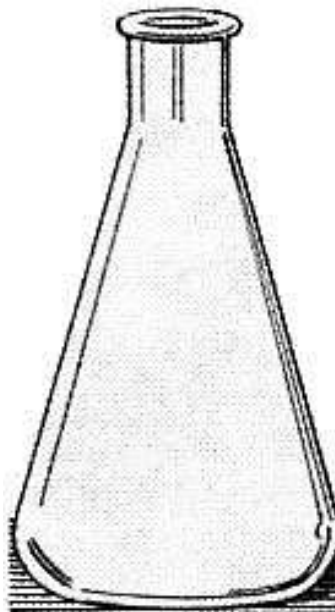
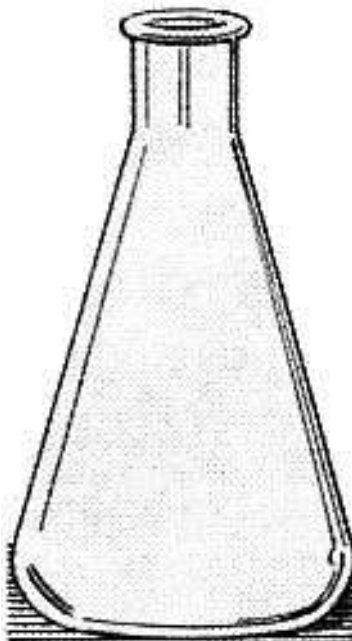
(b) A solution of NaOH is added slowly to the sample being analyzed. The sample is mixed.



(c) When the amount of NaOH added from the buret exactly equals the amount of H^+ supplied by the acid being analyzed, the dye (indicator) changes color.

What is happening in the Intro to titration Lab (Neutralization of HCl by NaOH)...

Draw three (3) Erlenmeyer Flasks. Under each condition record relative ratio of H^+ and OH^- .



Inside of the 1st write out the contents before the titrations.

The 2nd : Rxn taking place during the titration (*before* end point)

The 3rd : Content of flask at end points

Lab example: Neutralization of NaOH by HCl

35.62 mL of NaOH is neutralized with 25.2 mL of 0.0998 M HCl by titration to an equivalence point. What is the concentration of the NaOH?

Problem

What volume of 0.1 M HNO_3 is needed to completely neutralize 0.050 L of 0.2 M NaOH ?

What are we looking for?

What do we know

Acid Base Titration

Bell Work 5-May-2017

A. What is the major difference between a strong acid and a weak acid?

B. What is the concentration of NaOH in a burette if it took 18.1mL to neutralize 0.620g of K.H.P. (M.M. 204g/mol, $\text{C}_8\text{H}_5\text{KO}_4$) ?

(Hint KHP : NaOH is 1H^+ : 1OH^-)

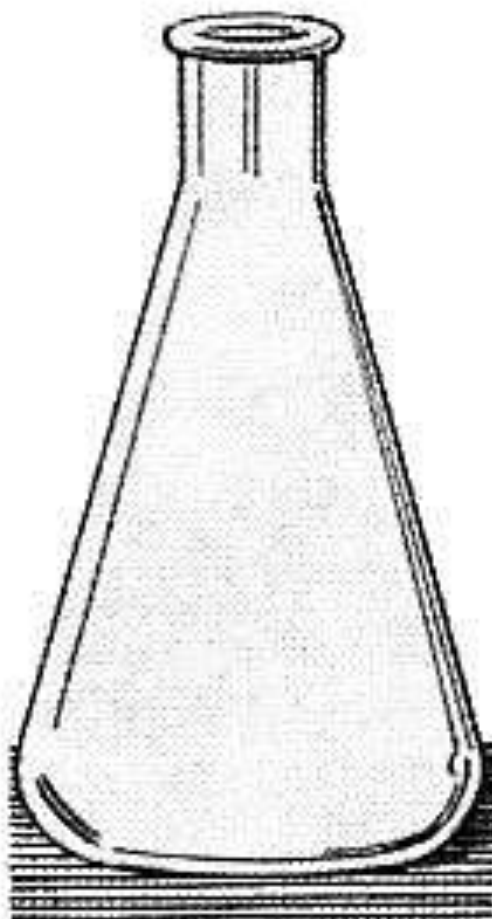
Agenda

Weak Acids Continued

Standardization of NaOH and pH Apple Juice Lab

Objective:

You will know how to find the H^+ of a weak acid give the equilibrium constant and be able to explain what a standardization titration is.



Standardization of NaOH Solution by Colorimetric Titration

Corrections

Page 2

“8: How much KHP would react completely with 15mL of ~~0.1M~~ **0.05M** NaOH?”

“Materials: ~~0.1M~~ **0.05M** sodium hydroxide (NaOH)”

Page 3

“5. Add ~ 50mL of ~~~0.1M~~ **~0.05M** NaOH to your buret”

Part II 1. Refill your buret to between the 0 and 5mL mark with the ~~~0.1M~~ **~0.05M** NaOH

Bell Work 8-May-2017

- I. What is the concentration of NaOH in a burette if it took 21.4mL to neutralize 0.500g of K.H.P. (M.M. 204g/mol, $\text{C}_8\text{H}_5\text{KO}_4$) during standadization?**
- II. Based on the pH of the NaOH you just standardized with K.H.P., what is the $[\text{H}^+]$ in a 5.0 mL sample of OJ if it took 12.2mL of NaOH to reach end point?**

EQ:

When does helping other not really help them

Agenda

Standardization of NaOH and pH Apple Juice Lab, Part II

Objective:

You will be able to explain what a standardization titration is at the atomic/ reaction level.

Standardization Titration Lab

Two part lab:

Part I: Titration 1 find molarity of NaOH

How many grams of KHP are you going to use?

What glassware will you use to make your KHP solution?

Standardization of NaOH and pH of Apple Juice

Bell Work 09-May-2017

- I. When 10.mL of 6.0M hydrochloric acid is added to an excess sample of marble (calcium carbonate) a gas is one of the products.
- II. Write a balanced rxn equation
- III. What is the pH of the acid before the reaction?
- IV. How many mole of the gas are produced?
- V. If the gas is collected at 28°C and 1.1atm, what volume is theoretically recovered?

Period 3

Bell Work 9.May.2017

Please goggle up and continue with Part II of the lab. When you are finished please sit and complete the problem on the board 😊



Standardization Titration Lab

Two part lab:

Part I: Titration 1 find molarity of NaOH

We will use a salt, KHP ($\text{KHC}_8\text{H}_4\text{O}_4$) to find the exact molarity of NaOH.

Once we know the molarity of the NaOH, we will...

Part II: Find molarity of unknown

Apple Juice,

**Again perform titrations to find the
exact molarity of your unknown**

Apple Juice

$[\mathcal{H}_3\text{O}^+]$, $[\text{OH}^-]$ and $p\mathcal{H}$

What is the pH of the 0.0010 M NaOH solution?

$$[\text{OH}^-] = 0.0010 \text{ (or } 1.0 \times 10^{-3} \text{ M)}$$

$$p\text{OH} = -\log(0.0010)$$

$$p\text{OH} = 3$$

$$p\text{H} = 14 - 3 = 11$$

OR

$$K_w = [\text{H}^+][\text{OH}^-]$$

$$[\text{H}^+] = 1.0 \times 10^{-11} \text{ M}$$

$$p\text{H} = -\log(1.0 \times 10^{-11}) = 11.00$$



A man went into the doctor for testing, the tests revealed that he had a $[\text{OH}^-]$ of 1.28×10^{-12} . What is the pH of his urine?

You Try 😊

The pH of rainwater collected in a certain region of the northeastern United States on a particular day was 4.82. What is the H^+ ion concentration of the rainwater?

You Try 😊

The OH^- ion concentration of a blood sample is $2.5 \times 10^{-7} \text{ M}$.
What is the pH of the blood?

Calculating $[\mathcal{H}^+]$, $p\mathcal{H}$, $[O\mathcal{H}^-]$, and $pO\mathcal{H}$

Problem 1: A chemist dilutes concentrated hydrochloric acid to make two solutions:

(a) 3.0 M

(b) 0.0024 M .

Calculate the $[H^+]$, pH , $[OH^-]$, and pOH of the two solutions at 25°C .

Calculating $[\mathcal{H}^+]$, $p\mathcal{H}$, $[O\mathcal{H}^-]$, and $pO\mathcal{H}$

Problem 2: What is the $[\text{H}^+]$, $[\text{OH}^-]$, and $p\text{OH}$ of a solution with $\text{pH} = 3.67$? Is this an acid, base, or neutral?

Problem 3: What is molarity of a solution made from 4.5g of NaOH dissolved to a volume 450ml? If you furture diluted it to 800ml what would its new molarity be?

Objective

Are you up to speed?

pH, $[H^+]$, etc. calculation practice

Calculating $[\mathcal{H}^+]$, $p\mathcal{H}$, $[\text{O}\mathcal{H}^-]$, and $p\text{O}\mathcal{H}$

Problem 4:

What is the $[\text{H}^+]$, $[\text{OH}^-]$, and $p\text{OH}$ of a solution with $\text{pH} = 8.05$? Is this an acid, base, or neutral?

Problem 5:

What is the $[\text{H}^+]$, $[\text{OH}^-]$, and pH of a solution with $p\text{OH} = 12.05$? Is this an acid, base, or neutral?

Calculating $[\mathcal{H}^+]$, $p\mathcal{H}$, $[\text{O}\mathcal{H}^-]$, and $p\text{O}\mathcal{H}$

Problem 6:

If 20ml of a 19.0M solution of NaOH is added to 2 480ml of water, what is the new molarity?

What is the *molality*?

What is the pH?

Homework

29-April-2016

Finish Acid Base Practice
#20-23; Titration

Bell Work 3-May-2016

A. What is the major difference between a strong acid and a weak acid?

B. What is the concentration of NaOH in a burette if it took 18.1mL to neutralize 0.620g of K.H.P. (M.M. 204g/mol, $C_8H_5KO_4$) ?

(Hint KHP : NaOH is $1H^+$: $1OH^-$)

Bell Work

2-May-2016

When 15mL of Nitric Acid is triturated with 21.5mL of 0.5M Potassium Hydroxide to neutralization:

1. Write a balanced equation *and* net ionic equation
2. What is the concentration of the nitric acid
3. What is the pH of the nitric acid?

$$M_{\text{acid}} V_{\text{acid}} = M_{\text{base}} V_{\text{base}}$$

The Weak Acid / Base Rxn

Recall a balanced equation.

What is on the left side?

The right side?

When you compare the concentration (molarity, [mol/L]) of all reactants and to all products you get something called and equilibrium expression.

Where “K” is the equilibrium constant for that rxn

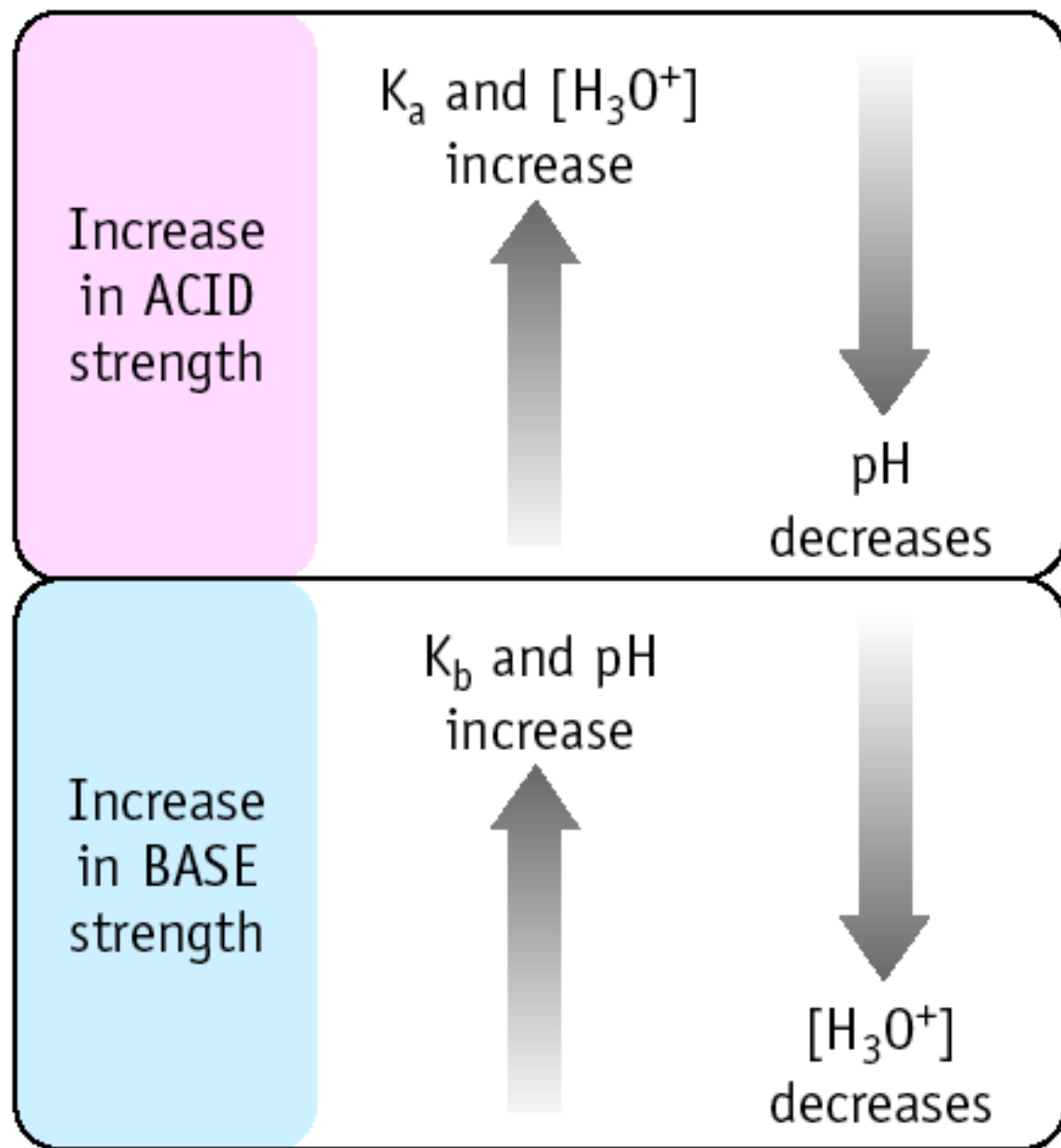
Equilibrium constants for Weak Acids



$$K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$$

Weak acid has $K_a < 1$

Leads to small $[\text{H}_3\text{O}^+]$ and a pH of 2 - 7



Relation of
 K_a , K_b ,
 $[H_3O^+]$ and
pH

I.C.E. Table Method

I = Initial concentration, M

C = Change concentration, M

E = Equilibrium concentration, M

RXN	HA→	H ⁺	A ⁻
I	[HA]	0	0
C	-x	+x	+x
E	[HA]-x	x	x

I.C.E. Table Method

Step 1: Write balanced equation

Step 2: Write equilibrium (K_a) expression

Step 3: Construct ICE table and fill in

Step 4: Solve for unknown concentrations
using equilibrium values, use $[\text{H}_3\text{O}^+]$ or
 $[\text{H}^+]$ to find pH if asked

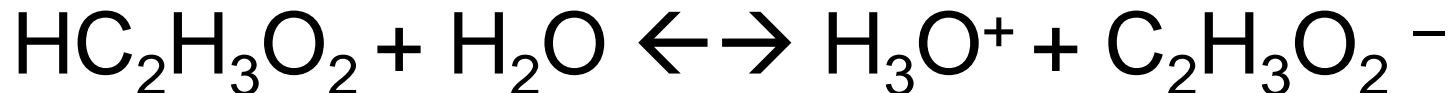
Practice

If the K_a of an acid, “A,” is 1.5×10^{-2} , what can you tell about its pH compared acid “B” who’s K_a is 6.2×10^{-4} ?

Equilibria involving weak acids

You have 1.00 M $\text{HC}_2\text{H}_3\text{O}_2$ Calc. the equilibrium concs. of $\text{HC}_2\text{H}_3\text{O}_2$, H^+ , $\text{C}_2\text{H}_3\text{O}_2^-$, and the pH. ($K_a = 1.8 \times 10^{-5}$)

Step 1. Write balanced equation.



or



Equilibria involving weak acids

You have 1.00 M $\text{HC}_2\text{H}_3\text{O}_2$ Calc. the equilibrium concs. of $\text{HC}_2\text{H}_3\text{O}_2$, H^+ , $\text{C}_2\text{H}_3\text{O}_2^-$, and the pH. ($K_a = 1.8 \times 10^{-5}$)

Step 2. Write equilibrium (K_a) expression.

$$K_a = \frac{[\text{H}^+][\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{HC}_2\text{H}_3\text{O}_2]}$$

Equilibria involving weak acids

You have 1.00 M $\text{HC}_2\text{H}_3\text{O}_2$ Calc. the equilibrium concs. of $\text{HC}_2\text{H}_3\text{O}_2$, H^+ , $\text{C}_2\text{H}_3\text{O}_2^-$, and the pH. ($K_a = 1.8 \times 10^{-5}$)

Step 3. Construct ICE table and fill in.

	$[\text{HC}_2\text{H}_3\text{O}_2]$	$[\text{H}^+]$	$[\text{C}_2\text{H}_3\text{O}_2^-]$
Initial	1.00	0	0
Change	-x	+x	+x
Equilib.	1.00-x	x	x

*Equilibria involving weak acids*¹³⁵

You have 1.00 M $\text{HC}_2\text{H}_3\text{O}_2$ Calc. the equilibrium concs. of $\text{HC}_2\text{H}_3\text{O}_2$, H^+ , $\text{C}_2\text{H}_3\text{O}_2^-$, and the pH. ($K_a = 1.8 \times 10^{-5}$)

Step 4. Solve for unknown concentrations using equilibrium values, use $[\text{H}_3\text{O}^+]$ or $[\text{H}^+]$ to find pH if asked

$$K_a = \frac{[\text{H}^+][\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{HC}_2\text{H}_3\text{O}_2]} = 1.8 \times 10^{-5} = \frac{[x^2]}{[1.0-x]}$$

This is a quadratic. Solve using quadratic formula.

or you can make an approximation if x is very small!

(Rule of thumb: 10^{-4} or smaller is ok)

Equilibria involving weak acids¹³⁶

You have 1.00 M $\text{HC}_2\text{H}_3\text{O}_2$ Calc. the equilibrium concs. of $\text{HC}_2\text{H}_3\text{O}_2$, H^+ , $\text{C}_2\text{H}_3\text{O}_2^-$, and the pH. ($K_a = 1.8 \times 10^{-5}$)

Step 4. Solve K_a expression

$$K_a = \frac{[\text{H}^+][\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{HC}_2\text{H}_3\text{O}_2]}$$

$$K_a = \frac{[x][x]}{[1.0-x]}$$

First assume x is very small because K_a is so small.

$$K_a = 1.8 \times 10^{-5} = \frac{x^2}{1.00}$$

*Equilibria involving weak acids*¹³⁷

You have 1.00 M $\text{HC}_2\text{H}_3\text{O}_2$ Calc. the equilibrium concs. of $\text{HC}_2\text{H}_3\text{O}_2$, H^+ , $\text{C}_2\text{H}_3\text{O}_2^-$, and the pH. ($K_a = 1.8 \times 10^{-5}$)

Step 4. Solve K_a approximate expression

$$K_a = 1.8 \times 10^{-5} = \frac{x^2}{1.00}$$

$$x = [\text{H}^+] = [\text{C}_2\text{H}_3\text{O}_2^-] = 4.2 \times 10^{-3} \text{ M}$$

$$\text{pH} = -\log[\text{H}^+] = -\log(4.2 \times 10^{-3}) \\ = 2.37$$

Practice

138

**What is the pH of a 0.020 M citric acid ,
 $\text{H}_3\text{C}_6\text{H}_8\text{O}_7$, solution? $K_a = 7.5 \times 10^{-4}$**

pH =? We need $[\text{H}^+]$ 1st $[\text{H}_3\text{C}_6\text{H}_8\text{O}_7] = 0.020\text{M}$

Weak acid, $K_a = 7.5 \times 10^{-4}$

Rxn	$\text{H}_3\text{C}_6\text{H}_8\text{O}_7$	H^+	$\text{H}_2\text{C}_6\text{H}_8\text{O}_7^-$
I			
C			
E			

$K_a =$ _____

So since $x = [\text{H}^+]$ then pH
must be?

Agenda

Weak Acids Continued

Standardization of NaOH and pH Apple Juice Lab

Objective:

You will know how to find the H^+ of a weak acid give the equilibrium constant and be able to explain what a standardization titration is.



Weak Acid Practice

If a 3.0M weak acid HF is used to etch glass, we need to find the concentration of $[H^+]$ ions in the solution.

1. Write the balance ionization/dissociation of HF.
2. Write the K_a expression for HF ionization!

From Bellwork

If a 3.0M weak acid HF is used to etch glass, we need to find the concentration of $[H^+]$ ions in the solution. Given the K_a of HF as 6.3×10^{-4} .

From Bellwork


If a 3.0M weak acid HF is used to etch glass, we need to find the concentration of $[H^+]$ ions in the solution. Given the K_a of HF as 6.3×10^{-4} .

Now use the quadratic equation ☺

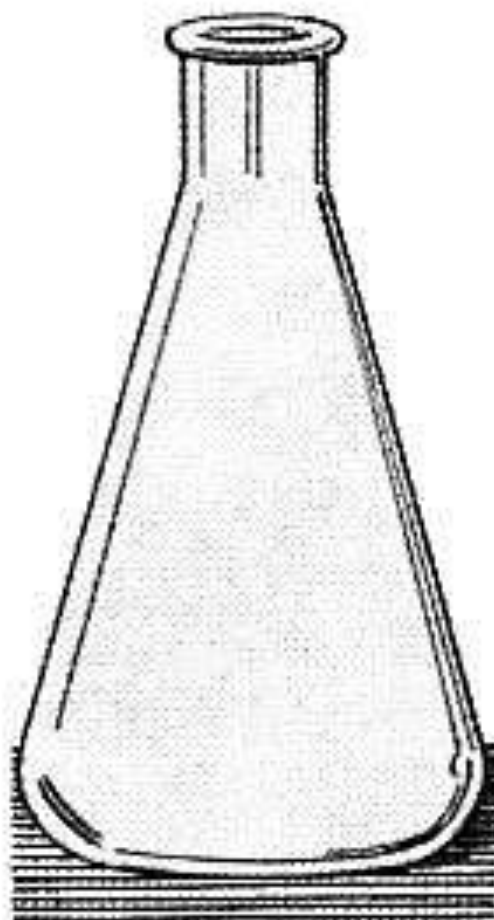
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

What is the pH of a 0.020 M Sulfurous Acid, H_2SO_3 , solution? $K_a = 1.4 \times 10^{-2}$

Rxn	H_2SO_3	H^+	HSO_3^-
I			
C			
E			



K_a is $>1.0 \times 10^{-2}$ so we need to use quadratic to solve for "x"



Standardization of NaOH Solution by Colorimetric Titration

Corrections

Page 2

“8: How much KHP would react completely with 15mL of ~~0.1M~~ **0.05M** NaOH?”

“Materials: ~~0.1M~~ **0.05M** sodium hydroxide (NaOH)”

Page 3

“5. Add ~ 50mL of ~~~0.1M~~ **~0.05M** NaOH to your buret”

Part II 1. Refill your buret to between the 0 and 5mL mark with the ~~~0.1M~~ **~0.05M** NaOH

Bell Work

4-May-2016

Before you sit down please get safety goggles.

The dissociation constant for a weak base is K_b . Given that $K_w = K_a \times K_b$ and that $K_w = 1.0 \times 10^{-14}$, what is the value of K_b ? For acetate ion if the K_a of acetic acid is 1.8×10^{-5} ?

Agenda

*Questions about K_a Expression from yesterday, K_b ?
You will standardize a NaOH sample*

Objective:

*You will know how to find the equilibrium
constant of a weak base*

Standardization Titration Lab

Two part lab:

Part I: Titration 1 find molarity of NaOH

We will use a salt, KHP ($\text{KHC}_8\text{H}_4\text{O}_4$) to find the exact molarity of NaOH.

Once we know the molarity of the NaOH, we will...

Part II: Find molarity of unknown Apple Juice,
Again perform titrations to find the exact molarity
of your unknown Apple Juice

Standardization Titration Lab

Two part lab:

Part I: Titration 1 find molarity of NaOH

How many grams of KHP are you going to use?

What glassware will you use to make your KHP solution?

Standardization of NaOH and pH of Apple Juice

Equilibrium constants for Weak Base



$$K_b = \frac{[\text{BH}^+][\text{OH}^-]}{[\text{B}]}$$

Weak base has $K_b < 1$

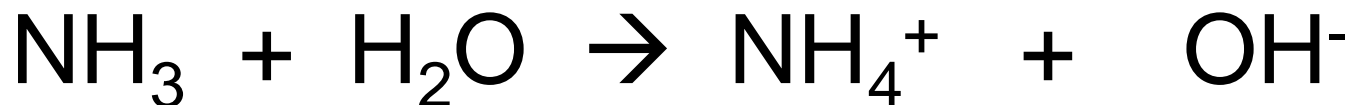
Leads to small $[\text{OH}^-]$ & a pH of 12 - 7

Equilibria Involving A Weak Base

You have 0.010 M NH_3 . Calc. the pH.

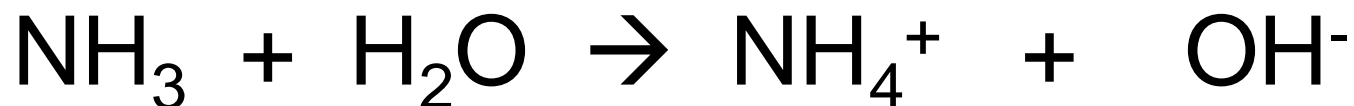
$$K_b = 1.8 \text{ E}^{-5}$$

Step 1. Write a balanced equation



Equilibria Involving A Weak Base

You have 0.010 M NH_3 . Calc. the pH.



$$K_b = 1.8 \text{ E}^{-5}$$

Step 2. Define K_b expression

$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]}$$

Equilibria Involving A Weak Base

You have 0.010 M NH_3 . Calc. the pH.



$$K_b = 1.8 \text{ E}^{-5}$$

Step 3. Define equilib. concs. in table

	$[\text{NH}_3]$	$[\text{NH}_4^+]$	$[\text{OH}^-]$
initial	0.010	0	0
change	-X	+X	+X
Equilib.	$0.010 - x$	x	x

Equilibria Involving A Weak Base

You have 0.010 M NH_3 . Calc. the pH.



$$K_b = 1.8 \times 10^{-5}$$

Step 4. Solve the equilibrium expression

$$K_b = 1.8 \times 10^{-5} = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} = \frac{x^2}{0.010 - x}$$

Assume x is small, so

$$x = [\text{OH}^-] = [\text{NH}_4^+] = 4.2 \times 10^{-4} \text{ M}$$

$$\text{and } [\text{NH}_3] = 0.010 - 4.2 \times 10^{-4} \approx 0.010 \text{ M}$$

The approximation is valid !

Equilibria Involving A Weak Base

You have 0.010 M NH_3 . Calc. the pH.



$$K_b = 1.8 \times 10^{-5}$$

Step 4. Calculate pH

$$[\text{OH}^-] = 4.2 \times 10^{-4} \text{ M}$$

$$\text{so } \text{pOH} = -\log [\text{OH}^-] = 3.37$$

Because $\text{pH} + \text{pOH} = 14$,

$$\text{pH} = 10.63$$

Now some practice ☺

The 1.0M weak base ethylamine ($\text{C}_2\text{H}_5\text{NH}_2$) has a K_b of 6.4×10^{-4} what is the pH of the solution (find $[\text{OH}^-]$ then convert to pH)

A 0.40 M solution of the lactate ion ($\text{C}_3\text{H}_5\text{O}_3^-$) (a weak base), has a pH of 8.728. Calculate the K_b of the lactate ion ($\text{C}_3\text{H}_5\text{O}_3^-$)

Now a hard one ☺

What is the K_a of the weak acid phenylacetic acid, $C_6H_5CH_2COOH$, if 2.1 % of the acid dissociates in a 0.12 M solution ?

Bell Work

9-May-2016

What is the concentration of 15ml of HCl that was neutralized using 0.75M NaOH at a volume of 12.5ml? What is the pH of the HCl?

$$M_{\text{acid}} V_{\text{acid}} = M_{\text{base}} V_{\text{base}}$$

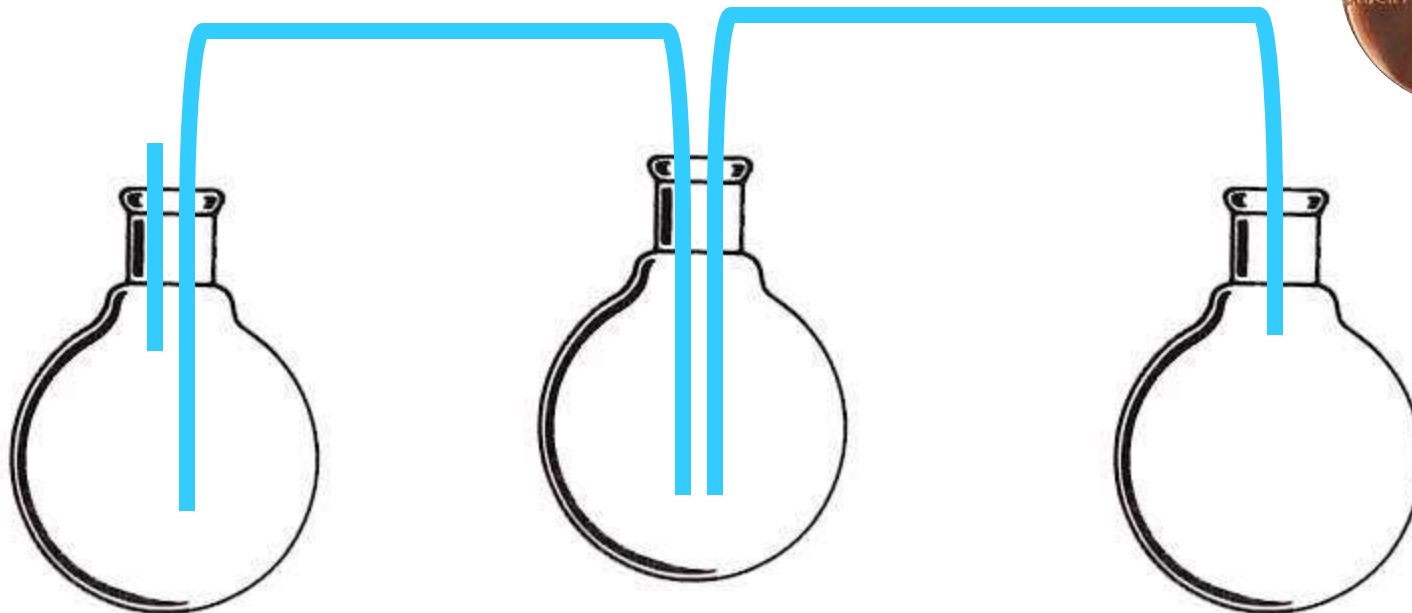
Turn in

Standardization Lab

Weak Acid Practice



Penny Fountain



70ml of 0.1M NaOH

150ml of 0.1M
 HNO_3 +
Phenophtalien

10ml of 16M HNO_3

What is the acid base reaction here?

Penny Fountain Redox Reaction

Nitric oxide (NO) is oxidized by atmospheric molecules, such as ozone (O_3) or hydrogen dioxide (HO_2), to form nitrogen dioxide (NO_2). Nitrogen dioxide (NO_2) reacts with OH in the atmosphere to form nitric acid (HNO_3).



Penny Fountain Redox Reaction



Balance as:



Penny Fountain Heat exchange



If the reaction took place in a sealed container submerged in 500mL of water at 20°C, what quantity of heat was exchanged if the water hit a maximum temperature of 35°C?

Penny Fountain

Gas Law Rxn



Given the balanced equation above, what volume of gas is produced at 23°C and 0.9atm, if a ____g penny is used?

Quick Quiz #2.7

1. On the pH scale bases would be what range?

2. In the rxn below what is the acid?



3. List the three strong acids you must know?

4. A 0.120 M solution of a generic weak acid (HA) has a pH of 3.26. Determine the K_a .

Quick Quiz #2.7

1. On the pH scale bases would be what range?

>7

2. In the rxn below what is the acid?



H₂O

3. List the three strong acids you must know?

HCl, HNO₃, H₂SO₄

4. A 0.120 M solution of a generic weak acid (HA) has a pH of 3.26. Determine the K_a.

2.53E⁻⁶

Bell Work
27-Mar-2014

What is a monoprotic acid?

What ratio would it react with a base with the following generic formula XOH ?

Agenda

Acid base buffer Lab

Acid base Buffer lab

Complete pre lab questions

Caution with 1.0M HCl

*Use “HCl Droppers” for Part 2 and return
when finished*

*Cautions when blowing air through straw
into solution 2*

All solutions down drain.

Homework

Finish Weak Acid Base Practice #6-10

Bell Work
23. April 2015

If a 1.0L solution of HClO has a pH of 4.1, what is the original concentration of the HClO acid ($K_a = 2.88 \times 10^{-8}$)?

Have your pre lab out for a Stamp!

Agenda

Relationship between K_a K_b and K_w

Weak Acid Base practice

Intro To buffera

Objective:

You will feel comfortable completing weak acid base calculations and be able to describe the purpose of a buffer

Turn In

Weak Acid/ Base tutorial Practice (second page only)

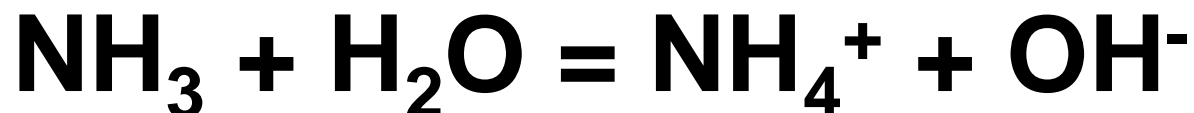
Conjugate Acids of Bases

After losing a H^+ , the acid species becomes the conjugate base. A base and its protonated partner also form a conjugated acid-base pair

$H^+ + \text{Base} = \text{Conjugate_acid of Base}^+$

$\text{Acid} = H^+ + \text{Conjugate_base of Acid}^-$

Conjugate Acids of Bases

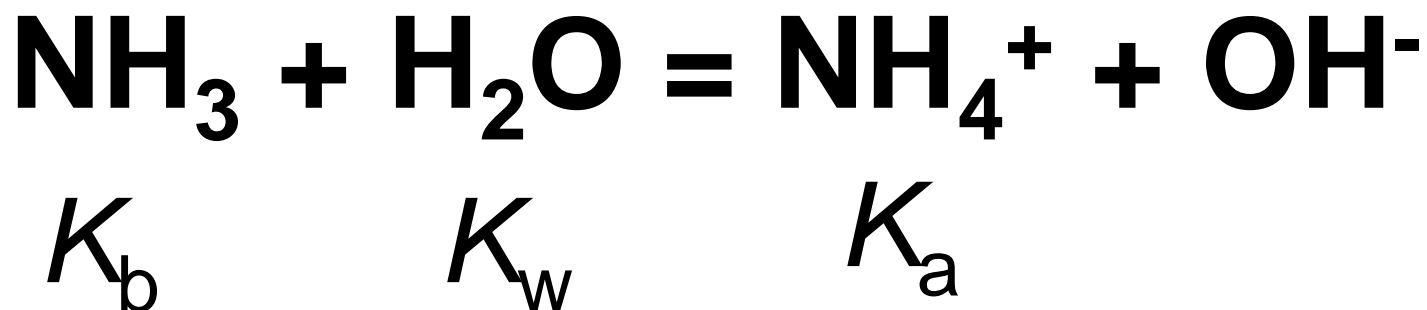


Thus, NH_4^+ and NH_3 are a pair of conjugate acids and bases, as are HAc and Ac^- .

Relation Between K_a and K_b

K_a Values of Conjugate Acids of Bases

We have used K_a and K_b as the acidic and basic constants of acids and bases. Now look at the relationship between K_a of the conjugate acid and K_b of the base? Water always plays a role in the conjugation acid-base pair.



K_a Values of Conjugate Acids of Bases

We have used K_a and K_b as the acidic and basic constants of acids and bases. Now look at the relationship between K_a of the conjugate acid and K_b of the base? Water always plays a role in the conjugation acid-base pair.

So...

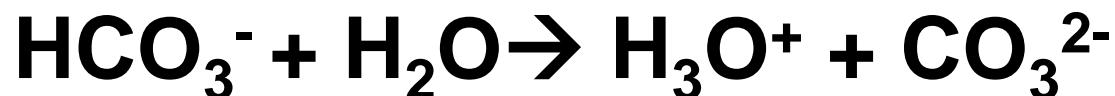
$$K_a K_b = K_w$$

Recall that is equal to 1.0×10^{-14}

K_a Values of Conjugate Acids of Bases

The K_a for HCO_3^- is 4.7×10^{-11} , what is the conjugate base and its K_b ?

Solution



$$K_a K_b = K_w$$

The conjugate base is CO_3^{2-} .

$$\begin{aligned} K_b &= (1 \times 10^{-14}) / (4.7 \times 10^{-11}) \\ &= 2.1 \times 10^{-4} \end{aligned}$$

Your Turn

The K_b for the anion of oxalic acid, $\text{C}_2\text{O}_4\text{H}^-$ is 1.8×10^{-10} . What is K_a for the oxalic acid?



Your Turn

Calculate K_b for the acetate ion from the K_a for acetic acid of 1.8×10^{-5}

What is a Buffer

<https://youtu.be/8Fdt5WnYn1k>

- 1. What is a buffer solution?**
- 2. A buffer solution is a mixture of...**
- 3. A buffer does what to pH?**

Closure

What are three non laboratory examples of buffer solutions?

Write in you notes!

Bell Work
24-April-2015

**What is my name, am I an acid
or a base:**



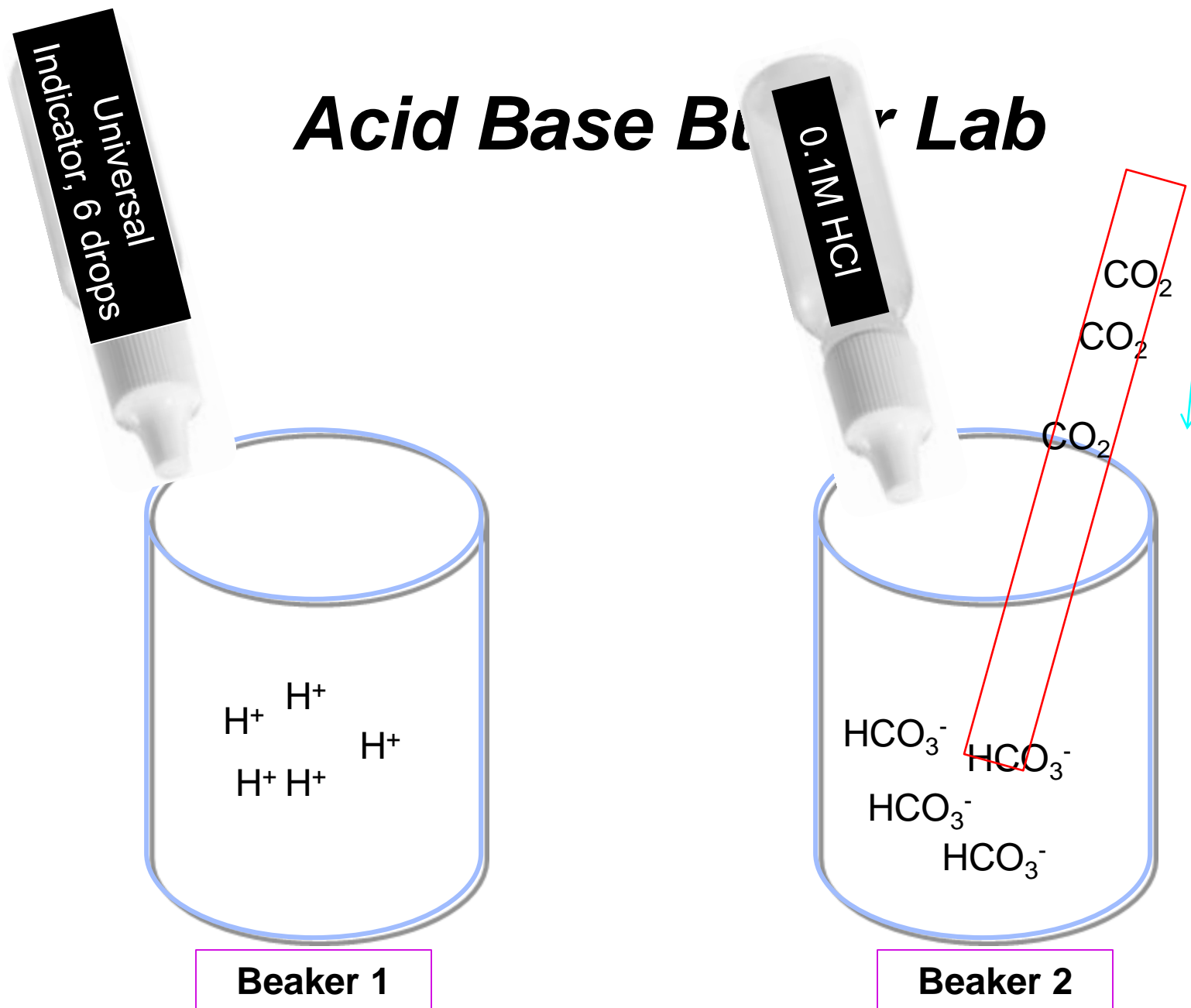
Agenda

Acid Base Buffer Lab

Objective:

You will be prepared for the exam tomorrow!

Acid Base Buffer Lab



Types of Acid/Base Reactions: Summary

Table 17.5 • Characteristics of Acid–Base Reactions

Type	Example	Net Ionic Equation	Species Present After Equal Molar Amounts Are Mixed; pH
Strong acid + strong base	HCl + NaOH	$\text{H}_3\text{O}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons 2 \text{H}_2\text{O}(\ell)$	Cl^- , Na^+ , pH = 7
Strong acid + weak base	HCl + NH_3	$\text{H}_3\text{O}^+(\text{aq}) + \text{NH}_3(\text{aq}) \rightleftharpoons \text{NH}_4^+(\text{aq}) + \text{H}_2\text{O}(\ell)$	Cl^- , NH_4^+ , pH < 7
Weak acid + strong base	HCO_2H + NaOH	$\text{HCO}_2\text{H}(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{HCO}_2^-(\text{aq}) + \text{H}_2\text{O}(\ell)$	HCO_2^- , Na^+ , pH > 7
Weak acid + weak base	HCO_2H + NH_3	$\text{HCO}_2\text{H}(\text{aq}) + \text{NH}_3(\text{aq}) \rightleftharpoons \text{HCO}_2^-(\text{aq}) + \text{NH}_4^+(\text{aq})$	HCO_2^- , NH_4^+ , pH dependent on K_a and K_b of conjugate acid and base.

Types of Acid/Base Reactions: Summary

Rules for naming acids:

Acid base definitions:

Litmus paper colors:

Titration calculations:

Bell Work
27-April-2015

What is a standardization?

**KHP used to do what in the
Standardization of NaOH lab
today?**

Objective

You will determine the exact concentration of NaOH you will use to titrate against apple Juice

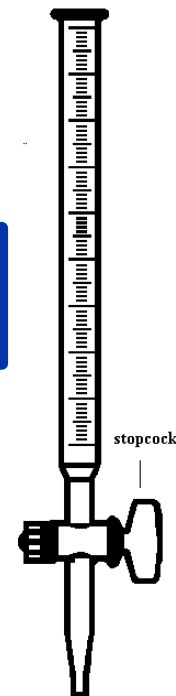
Titration Review

	Trial 1	Trial 2	Trial 3	Trial 4
Grams of KHP				
Moles of KHP				
Final Burret Reading (ml)				
Amount of NaOH dispensed (ml)				
Initial Burret Reading (ml)				
Molarity of NaOH acid				

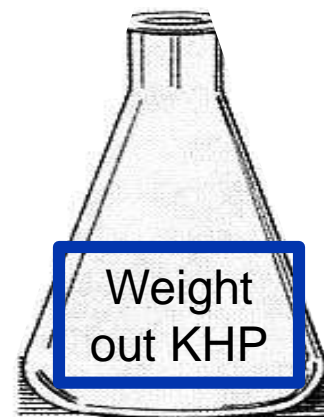
Day 1

1. Prepare buret with ~50ml of NaOH. Do Not return NaOH to stock bottles!
2. Determine exact mass of KHP (~ 1.5×10^{-3} mole, F.W. 204g/mol) being used.
3. Add DI water and 2-3 drops of **phenolphthalein** to solution, swirl to dissolve.
4. Titrate to find vol. NaOH needed to neutralize KHP.
5. Repeat steps 2-4 for a minimum of 3 trials.

Unknown
[NaOH]



Weight
out KHP



All waste down drain

Bell Work
28-April-2015

What is the average molarity of your NaOH from day 1?

If you are not working on the lab calculations you will miss completing the lab today.

Period 1: Have your Buffer lab out and ready to turn in

Objective

You will determine the pH apple Juice using your standardized NaOH.

Day 2

1. Prepare burret with ~50ml of NaOH. **Do Not return NaOH to stock bottles!**

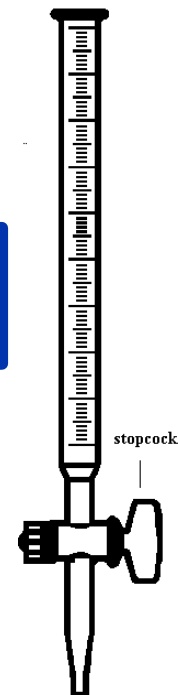
2. a. Add 10mL (record exact amount) apple juice to Erlenmeyer flask.

b. Add 15mL DI water and 2-3 drops of phenolphthalein to solution, swirl to dissolve.

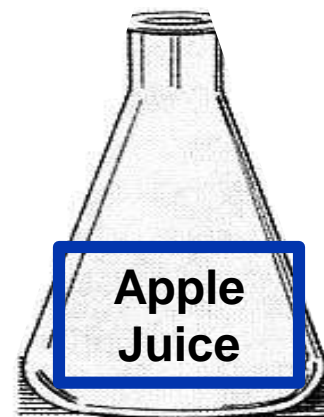
4. Titrate to equivalence point.

5. Repeat steps 2-4 for a minimum of 3 trials.

Known
[NaOH]



Apple
Juice



All waste down drain

**Complete calculations/
post lab for both Part I
and Part II**

**Due tomorrow
29.April.2015**

pH testing

There are several ways to test pH

- Blue litmus paper (red = acid)
- Red litmus paper (blue = basic)
- pH paper (multi-colored)
- pH meter (7 is neutral, <7 acid, >7 base)
- Universal indicator (multi-colored)
- Indicators like phenolphthalein
- Natural indicators like red cabbage, radishes

Red litmus paper with a drop of base here



Blue litmus paper with a drop of acid here



Paper testing

Paper tests like litmus paper and pH paper





- Place a drop of the solution from the end of the stirring rod onto a piece of the paper
- Read and record the color change. Note what the color indicates.
- You should only use a small portion of the paper. You can use one piece of paper for several tests.



pH paper

Behavior of Salts in Water

Table 18.8 The Behavior of Salts in Water

Salt Solution (Examples)	pH	Nature of Ions	Ion That Reacts with Water	
Neutral [NaCl, KBr, Ba(NO ₃) ₂]	7.0	Cation of strong base Anion of strong acid	None	
Acidic [NH ₄ Cl, NH ₄ NO ₃ , CH ₃ NH ₃ Br]	<7.0	Cation of weak base Anion of strong acid	Cation	
Acidic [Al(NO ₃) ₃ , CrCl ₃ , FeBr ₃]	<7.0	Small, highly charged cation Anion of strong acid	Cation	
Basic [CH ₃ COONa, KF, Na ₂ CO ₃]	>7.0	Cation of strong base Anion of weak acid	Anion	

pH meter

Tests the voltage of the electrolyte

Converts the voltage to pH

Very cheap, accurate

Must be calibrated with a buffer solution



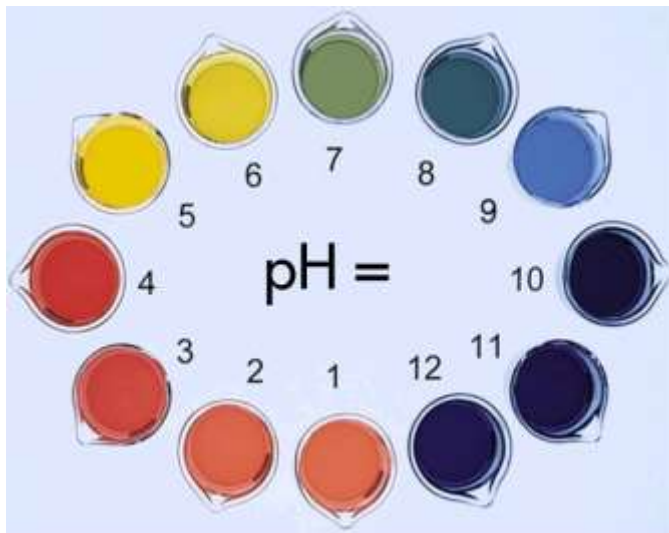
pH indicators

Indicators are dyes that can be added that will change color in the presence of an acid or base.

Some indicators only work in a specific range of pH

Once the drops are added, the sample is ruined

Some dyes are natural, like radish skin or red cabbage



Bell Work
11-May-2017

**Clear your desk and get out a
calculator, periodic table,
and blank piece of paper 😊**

Turn In

1. **Weak acid weak base practice**